VOLUME XI

The Book of Knowledge

The Children's Encyclopedia

THAT LEADS TO LOVE OF LEARNING

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The

BOOK OF KNOWLEDGE

The Children's Encyclopedia

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Contents of Volume XI

This is a guide to the principal contents of this volume. It is not possible to give all of the questions in the Department of Wonder, but the pages are given where such sections begin. The big Index in Volume 20 is a guide to your whole set. There you will find every subject that is in THE BOOK OF KNOWLEDGE.

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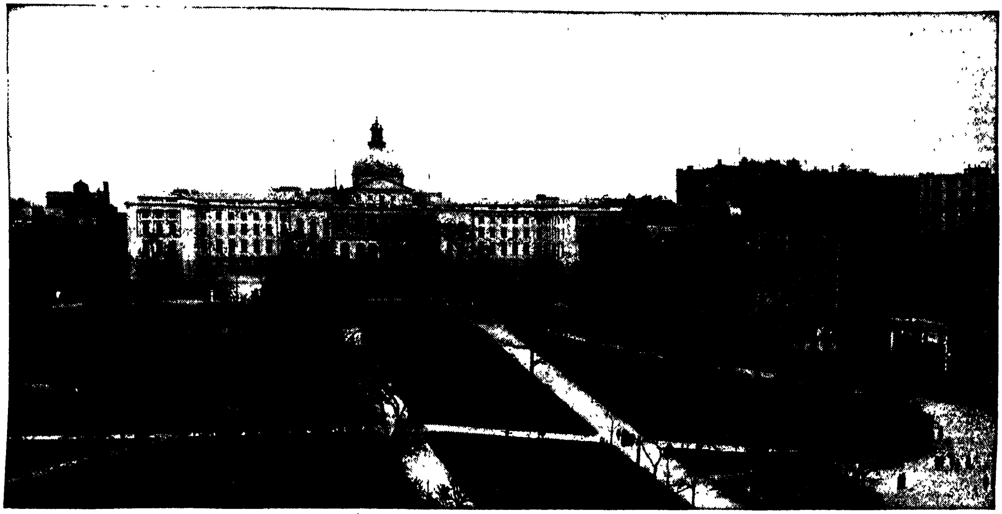


Photo, George Brayton

The State House in Boston, viewed across Boston Common.

THE NORTHEASTERN STATES

PART II

THE section which we call the Northeastern States is made up of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland and Delaware, eleven states in all. In our first story of these states, in Volume Ten, we told you something of the geology, the agriculture and the forests of this section. However, only a small part of the population is engaged either in agriculture or lumbering. We come now to mining and manufacturing which employ a much larger proportion of the people.

The chief mineral products of the section are coal, petroleum, natural gas, limestone, marble and granite. Pennsylvania ranks second among the states of the Union in the value of mineral products, with 11 per cent of the total output. No other state in this group can be considered as an important mining area, since no one of them produces as much as 2 per cent of the total value of mineral products.

Most of the anthracite, or hard, coal mined in the United States is found in the Ridge and Valley section of Pennsylvania, with Scranton and Wilkes-Barre as the main centres. Bituminous, or soft, coal is more widely distributed, yet Pennsylvania produces around 25 per cent of the total. Some of the pictures in our story of Coal beginning on page 785 were made in Pennsylvania.

Pennsylvania produces a little copper; New York, New Jersey and Pennsylvania a very small amount of iron; from New York we get a little lead; New York and New Jersey supply around one-sixth of the country's production of zinc. More than 20 per cent of the country's production of Portland cement comes from Pennsylvania and New York; and 20 per cent of the country's production of salt comes from New York.

Originally Pennsylvania was the chief petroleum and natural-gas area also, but the wells have been yielding less and less, until to-day the state stands lower in this respect. It was the discovery of petroleum in Pennsylvania that put an end to a romantic industry of the Northeast, namely, whaling. Kerosene became so cheap that it was no longer profitable to fit out ships to seek the whale for whale oil, which had been used up to that time.

Limestone is mined in Pennsylvania and New York in quantities, where it is used in part to mix with iron ore as a flux in the process of separating the iron from the ore.

Although not large in value compared with some other minerals, the marble and the granite quarries of Vermont and the granite of the New England states have a wide reputation. Vermont furnishes one-fourth of all the marble produced in the United States. Most of New England is granite; one hears of the "granite hills"; and New Hampshire is called the "Granite State." All of this granite is not of the same value. Most granites that will break into blocks will do for paving-stones, curbstones and building foundations, but if a stone for a monument or a statue is desired, the rock must have certain definite characteristics. There must be an even texture; that is, all the crystals must be of about the same size and preferably of small size. There should be also a uniform color throughout. Again, all granites do not polish with equal ease, and all do not carry lettering with the same degree of clearness. Some of the New England granites are suitable for monuments, statues and inscriptions, and many of these stones are shipped to distant places. A number of valuable quarries dot the Northeast. Vermont, Massachusetts, Pennsylvania, Maine and New Hampshire are important granite-producing states.

We have seen that the section is not the most important from the standpoint of agriculture and that, except for Pennsylvania, the mineral resources are not large. When we come to manufactures, however, the story is different.

The census of the United States tabulates sections of the United States according to the value of their manufactured products. Second place is given to the Middle Atlantic states (New York, New Jersey and Pennsylvania), first place to the East North Central states (Wisconsin, Michigan, Illinois, Indiana and Ohio) and fourth place to New England. This does not tell the whole story. The "value added by manufacture" is a very important item. Let us see what this means.

In some goods the factory adds little to the value of the raw material. For example, flour is not worth so very much more than wheat. On the other hand, the cost of the raw material used in making the works of a watch is much less than the price for which the movement sells. We say that the "value added by manufacture" is greater in the

Photo, Ewing Galloway

Vermont produces more granite than any other state, and has some noted quarries. This is the "Rock of Ages" quarry near Montpelier, from which great blocks are broken out to be sent over the United States. The state also stands high in the production of marble for buildings and statues.

A coal mine in the Lykens Valley district of the anthracite (hard coal) region in northeastern Pennsylvania. Almost all of the anthracite coal contained in the United States is found in this region. Pennsylvania's anthracite field covers an area of almost 484 square miles.

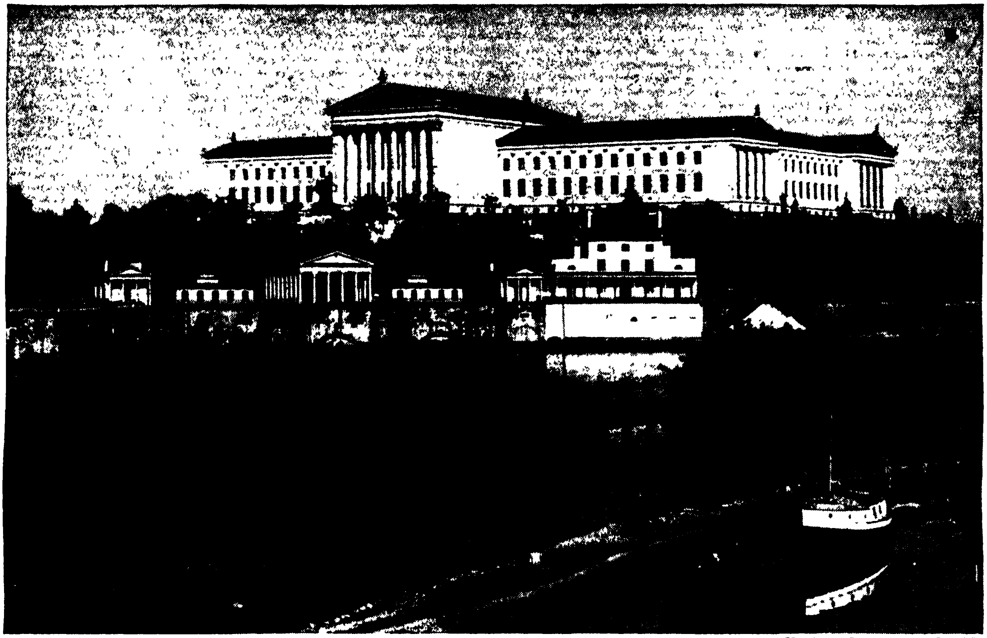
second case, and in much of the manufacturing in this section the value of the raw materials is greatly increased by the skilled labor used upon them.

In ranking the states of the United States on this basis it is found that New York leads, Pennsylvania is second, Massachusetts sixth, New Jersey seventh, Connecticut eleventh and Rhode Island twenty-fourth. But states differ much in size. A better way to find out how important the manufactures are in the life of a state is to divide the total value added by manufacture by the number of square miles in the state. If we do this we find that Rhode Island in many years leads all the other states. A square mile of this state averages more than any other state.

Manufacturing demands power. The hilly character of the land in this section makes possible the artificial damming of streams at short intervals. The glacial invasion, by dumping débris in the valleys, turned many streams from their original courses. These streams, in cutting down their new valleys, found ledges that were not easily worn away and appear now as falls and rapids. Niagara River is a stream which was diverted and now falls over a cliff. These falls and rapids are common in the glaciated area, and early manufacturing concerns found them advantageous as power sites. Some manufacturing villages are named because of falls or rapids, as, for example, Little Falls, New York, and Chicopee Falls, Massachusetts. Later the falls did not furnish enough power for increasing manufacturing, and steam power was substituted in part. Since a large part of the coal of the United States is in this Northeastern section, it continued to hold the advantage. Now the tendency is toward electric power generated by water. But as this type of power can be transported, the factory site may be located at a place which meets other demands of manufacturing.

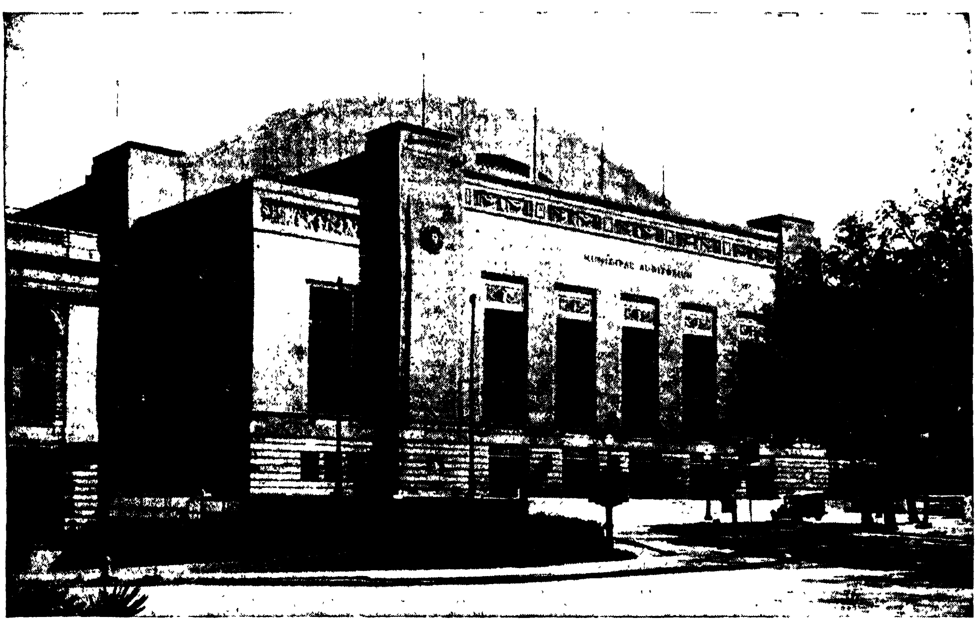
A Super-Power Plan has been considered for the area from Boston to Washington. If it should be completed—possibly in connection with the Great Lakes-St. Lawrence Waterways power project which has also been considered for years—power could be served to cities and towns and factories from a main source far away. If such a plan should be adopted, it would have many advantages. It has been estimated that in New England alone the project might save many millions of dollars in coal each year, and at the same time free the manufacturing cities

TWO PUBLIC BUILDINGS IN PHILADELPHIA



Ewing Galloway, N. Y.

This beautiful home of the Pennsylvania Museum of Art, in Philadelphia, a city where history, art and industry meet, is designed to be a living, active and inspiring centre of beauty for years to come. It stands at one of the entrances to Fairmount Park. In front are the buildings of the Philadelphia Aquarium.



Acme Newspictures, Inc.

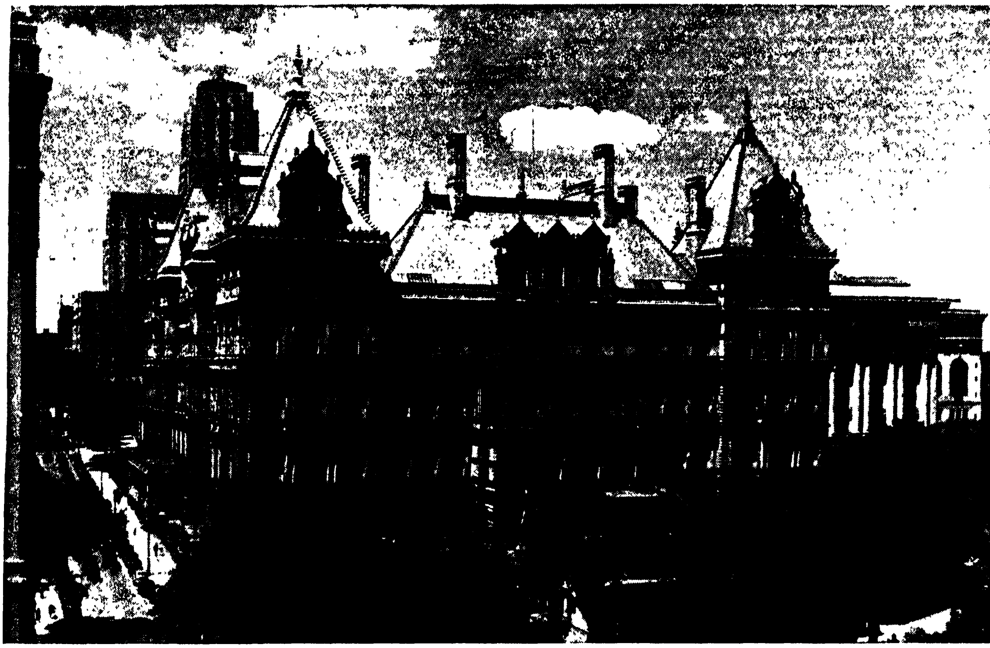
The Municipal Auditorium, in Philadelphia. The United States Mint, the Free Public Library and the Post Office and Court House are also among the handsome new buildings in the city. Most visitors, however, are eager to see the historic Independence Hall, Carpenter's Hall and other relics of Colonial and Revolutionary days.

THE CITY OF IRON AND STEEL

This memorial building is Pittsburgh's tribute to her gifted son, Stephen Collins Foster, composer of Old Folks at Home, My Old Kentucky Home and Old Black Joe. There is an auditorium in the Memorial, seating 700 persons, used for lectures, concerts and dramatic productions given by students of the University of Pittsburgh.

Pictures, courtesy, Pittsburgh Chamber of Commerce

The Allegheny River on the left and the Monongahela on the right come together at the point in the foreground, to form the Ohio River. The section of the city that you can see, from the skyscrapers down to the point is often called the Golden Triangle, for it is one of the most compact business areas in the world.



Courtesy, New York Bureau of State Publicity
The State Capitol of New York, at Albany, is regarded as one of the most important works of H. H. Richardson, of whom we tell you more in the story of American Architecture. New York is the most heavily populated state. In fact, only five other states have even half so many people.

from their blanket of smoke.

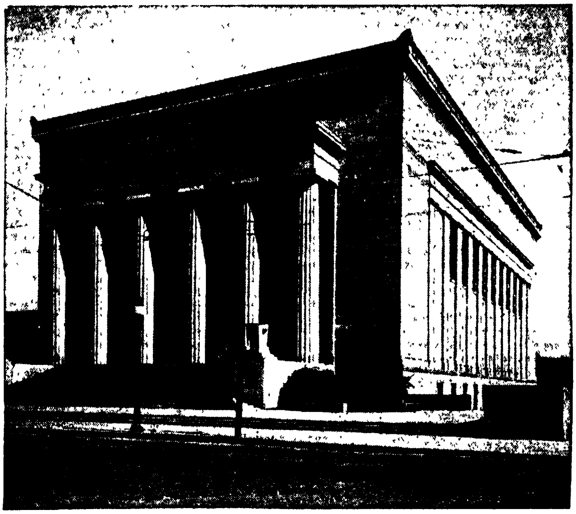
Some countries of Europe which have little or no coal have to depend very largely upon falling water to generate power for lighting and for turning the wheels of industry. This source of power is often jokingly called "white coal." Norway and Sweden, rich in waterfalls, both make use of "white coal" to run their trains and factories and to furnish light and power for farm work.

Another necessity of manufacturing is raw materials. Very curiously, this area is lacking in this respect. Most of the materials for manufacturing come from distant places. New Jersey, for example, is a leader in two industries—the dyeing and finishing of textiles, and the smelting of copper. Of these only the former obtains its materials for manufacture within the borders of the state. Massachusetts stands high in the manufacture of boots and shoes, rubber boots and woolen goods. There is another side to the story, however. If raw materials—rubber, for instance—can not be manufactured in the locality where they grow, then places on regular transportation lines have a distinct advantage. Since the East is one of the gateways of the country, and since practically all the harbors of the East are in the Northeastern section, the other sections of the country are at a disadvantage so far as foreign raw materials are concerned. New York City is the greatest port in the land, and goods of all varieties pass through it. Therefore that city is well located for receiving much raw material of manufacturing.

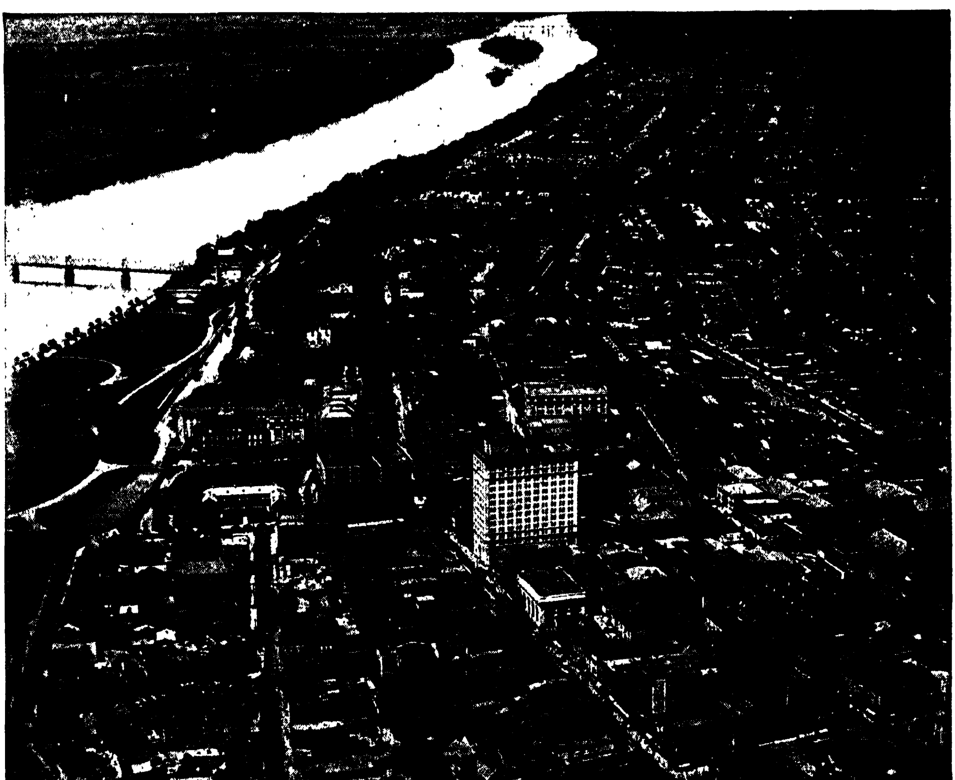
On the other hand, in an article like cotton, grown in this country, there is a question about the advantages of manufacturing. The cotton-growing states have built many mills, and now they have overcome the supremacy of the Northeast in cotton-manufacturing. Massachusetts stands fifth among all the states in cotton manufacturing. The four states at the head of the list are in the Southern area. In fact, the South now does about four-fifths of the cotton-manufacturing. Nearness to raw materials, lower wages and certain other advantages have overcome the former leadership of New England.

There are other kinds of raw materials that are manufactured at the sources—those of a perishable nature. Canning and preserving in order of rank by states is given as follows: California, New York, Illinois, New Jersey and Pennsylvania. Can you tell what are the articles handled in each case? Can you tell why?

SCENES IN TWO STATES



Baltimore, Maryland, is called the "monumental city." The War Memorial, recently completed at the joint expense of state and city, contains a memorial hall, an auditorium and meeting-rooms for patriotic societies. The tall column is the Washington Monument, with the Lafayette Statue in front.



This air view of Trenton, the capital of New Jersey, shows a part of the city on the Delaware. The city leads in the manufacture of pottery and has other important industries.

Baltimore photos, J. H. Schaefer & Son; photo of Trenton, copyright, Aero Service Corporation

Courtesy, U. S. Department of Interior

From colonial times New Englanders have been fishermen. Into harbor at Boston, Gloucester and Portland come the boats, loaded with cod, haddock, halibut and other fish. Above, a load of mackerel.

A third demand of manufacturing is a market. Its location is important in some cases. Thus agricultural implements are manufactured largely in the agricultural section of the country. Illinois, Wisconsin and Ohio have much the largest production of implements. But textile-mill machinery is manufactured in mill areas, and the outstanding area for this type is the Northeast. In general, however, the greatest demand for most products is in the area of densest population, and in the United States the belt from Boston to Washington is, above all others, the most densely settled area. This area, then, is the nation's greatest market.

A fourth necessity is a supply of labor. One would not build a cotton mill in the middle of a desert where there are no people, but in a locality where there are plenty of people to work. If one watches the people pouring out of a large factory at noon or night it is easy to realize that the workers must be crowded into a limited area. The Northeastern section, then, has three of the four great needs of manufacturing—it has power, transportation and labor—and these have given the people the opportunity which the poor conditions for agriculture denied them.

THE INDUSTRIES THAT HAVE BEEN BUILT UP AROUND CERTAIN LOCALITIES

This means that very frequently only one product is manufactured in a particular locality, and it is interesting to note the number of useful articles that are made almost entirely in this great manufacturing section. Most of the cotton cloth was made here until the Southern states began manufacturing on a large scale. So perhaps in time some of these other products will be made in quantities elsewhere.

Until recently half the boots and shoes were made in four states—Massachusetts, New York, New Hampshire and Pennsylvania. Massachusetts alone made 25 per cent of them. Brockton, Lynn, Haverhill and Boston were the great shoe towns. In recent years the industry seems to be moving to the Middle West, nearer the source of raw materials and the markets.

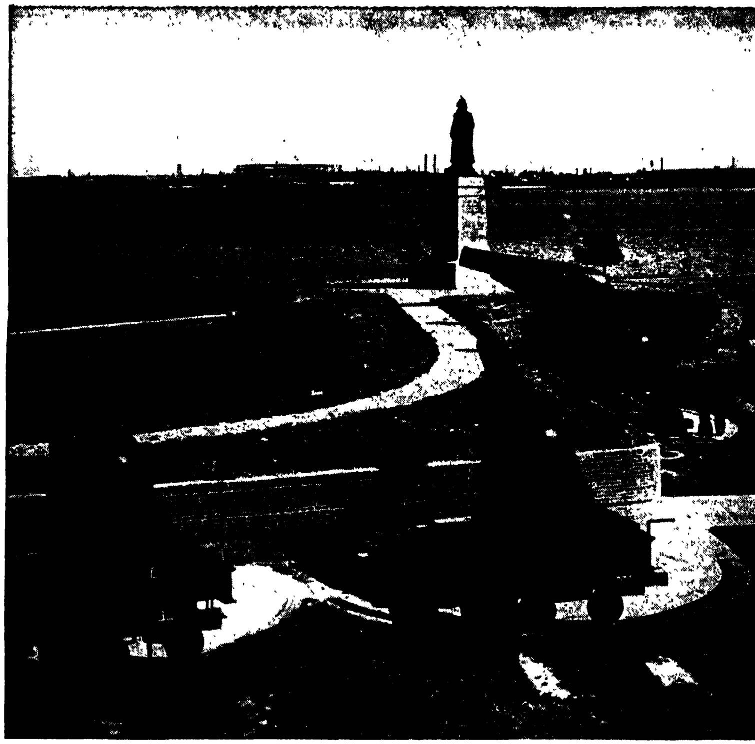
More than half of the jewelry is made in two centres, one about New York City and the other about Providence, Rhode Island. The bulk of the silk goods is made in Pennsylvania, New Jersey, Massachusetts, Rhode Island and Connecticut. Paterson, New Jersey, is a large centre of this industry. Most of the woolen and worsted goods is made in Massachusetts, Maine, Connecticut, New Hampshire and New York.

There are many such products which are listed in the census reports, and they give a very good understanding of the various sections of the country. However, many of them, for some good reason, are not manufactured at all in this area.

THE MAJORITY OF THE PEOPLE OF THIS AREA LIVE IN THE CITIES AND TOWNS

The New England states, according to the last census, are 76.1 per cent urban and 23.9 per cent rural; the Middle Atlantic states are 76.8 per cent urban and 23.2 rural; Delaware is about 52.3 per cent urban; and Maryland about 59.8 per cent urban. Individual states in this group range from Rhode Island, 91.6 per cent urban, to Vermont, 34.3 per cent urban. However, of the Northeastern group of states, Maine and Vermont

SCENES IN EASTERN STATES



Courtesy, Tourist Development Bureau, Baltimore
Right, Fort McHenry, near Baltimore, Maryland, now a National Monument. When the fort was being bombarded by the British, in 1814, Francis Scott Key wrote The Star Spangled Banner.

Courtesy, Boston and Maine R.R.
Winter comes early in the New England hills, and stays late, offering plenty of healthful sport to those who find the cold stimulating.

Courtesy, Bethlehem Steel Co.

With the entrance of the United States into World War II, the building of ships was greatly increased, both merchant marine vessels and fighting craft of all types. There are many important shipyards in the Northeastern area along the Atlantic seaboard.

stand alone in having rural populations that are larger than the urban ones.

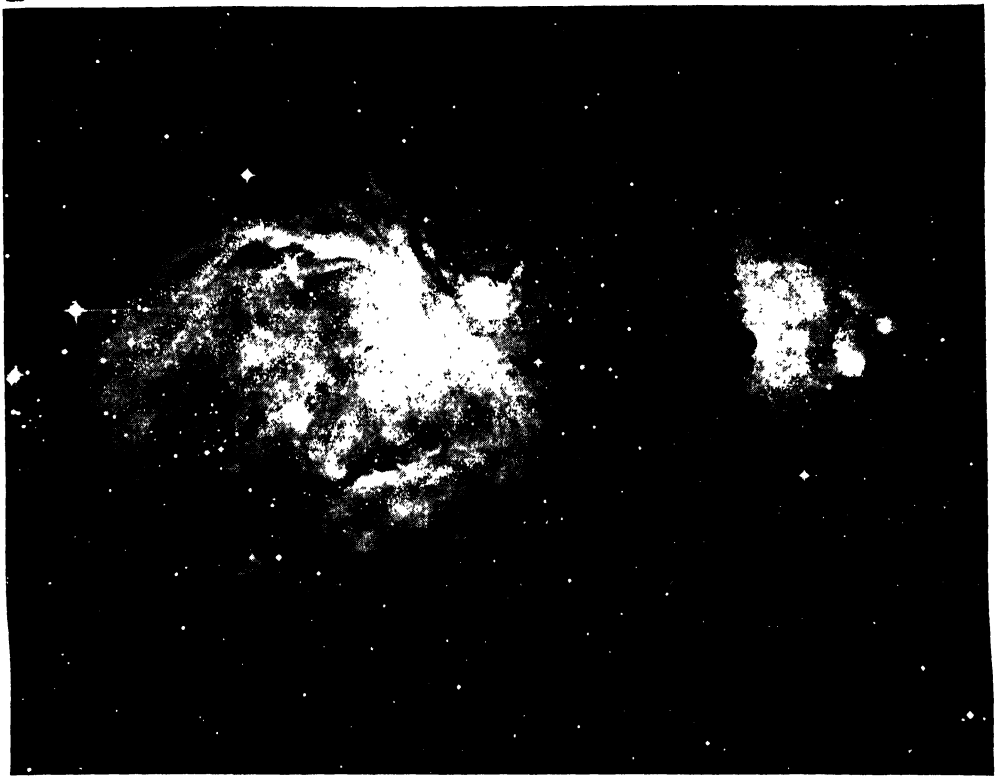
Compare either of the two groups of states mentioned above with the South Atlantic states, which have only 38.8 per cent of their population urban and 61.2 per cent rural.

Out of the fifty largest cities listed for the United States, thirteen are in this Northeastern area. They are, with their rank: New York (1), Philadelphia (3), Baltimore (7), Boston (9), Pittsburgh (10), Washington (11), Buffalo (14), Newark (18), Rochester (23), Jersey City (30), Providence (36), Syracuse (41) and Worcester (42). In addition to the fifty largest cities, forty-two others in the Union had more than 100,000 inhabitants in 1940, and nineteen of them are in this section.

Again, of the cities of the United States having 25,000 inhabitants or more, Massachusetts with 32, Pennsylvania and New Jersey, each with 25, and New York with 23, equal and exceed all states but Ohio, with 26, and Illinois, with 23. Delaware has one such city; New Hampshire, Maine and Maryland have three each; Rhode Island has 8; and Connecticut 15. Vermont has but one.

Most of the cities in the group of fifty largest cities have a number of important activities. Few are given over to one industry. New York is listed as leading all cities in the United States in the manufacture of clothing, fur goods, ink, jewelry, millinery, pens, tobacco-pipes, soap and cigars. It is a wide variety but if one lists the items in which the city stands in second and third places, the numbers of them become confusing. Other Eastern cities are similar in character, but have a smaller number of leading industries. Many of these cities are, in addition, business centres for extensive manufacturing enterprises in the surrounding cities and towns. Thus Boston, while it does not excel in any industry, gets much business from adjacent manufacturing centres. The city, for this reason, is the country's greatest wool market. Some of the smaller cities are notable because their industry is almost the sole producer of certain products. Thus, Troy, New York, produces the great bulk of the collars and cuffs; Waterbury, Connecticut, about a quarter of the needles, pins and hooks and eyes; and Gloversville, New York, a good part of the gloves and mittens.

THE NEXT STORY OF THE UNITED STATES IS ON PAGE 3937.



Lick Observatory

The Great Nebula in the constellation Orion, a vast cloud of gas lighted up by neighboring stars.

WHAT THE STARS ARE

TO the ancient shepherd or early astronomer, a star was but a flickering point of light in the sky, seeming almost about to be blown out by every passing breeze. Some thought of the stars as little glittering gems set in the solid dome of the sky. Only after many weary centuries had rolled past did some men suggest that perhaps the stars are really large and very hot and very bright, like the sun, and that only their great distance makes them appear faint.

Today we know this is true; the sun is a star, and it is only because it is so close to us that it appears more important than the other stars. But that closeness is only relative; as measured in ordinary terms, the sun is very far away. If we should somehow be able to fly to the sun in a transport plane traveling at a speed of 250 miles per hour, we should need to start out early in life, for more than forty years would be required to make the trip! Well, if an airplane is too slow, suppose we ride a rifle bullet; that travels much faster than an airplane. This would help, but even then it would take us almost five years to get to the sun.

The sun is the nearest star, and certainly the most important one to us, for the earth and all the other planets revolve around it, forming what is called the solar system. From the sun we get all our light and life.

Like the sun, the other stars are great glowing masses of gas, shining by themselves. They are not burning, as a piece of coal or wood burns; if they were burning, they would all have burned up long ago. They are glowing—they are incandescent. So the

stars, though glowing, last a long time; most of them show no change of any kind, even after many, many centuries have passed. Our star, the sun, has been shining as it is today for at least many millions of years.

One of the great mysteries until very recently has been the secret of the energy of the stars. Why do they shine? Where do they get the energy that they pour out in all directions in space?

In 1937, a scientist was able at last to tell us why the stars shine. Deep in the heart of a star, the temperature is very high—millions of degrees. The atoms, or little pieces of which all matter is composed, are moving along very fast, because of this high temperature. They smash into each other, colliding with very high speeds, and sometimes they do considerable damage to each other. When atoms are smashed and rearranged, we can get energy out of them, so the smashed atoms inside the sun give off energy, and this energy struggles upward from the heart of the star until at last, in the form of visible light and heat, it reaches the surface and starts on its endless journey through space. Only a tiny bit of the energy of a star falls on any obstacle in space and gets stopped; most of it slips between planets and stars and all other bodies and keeps on going, we know not whither.

If the sun is so far away that a rifle bullet could not make the journey in much less than five years, then the other stars must be unbelievably far away. Even the nearest of them is many thousands of times farther away than the sun. We must choose something faster than an airplane, faster even than a rifle bullet, for our journey to the nearest star.

The astronomer uses a pulse of light for his messenger from the stars. All that we know of every star we have learned from the light that comes to us across the great ocean of space that separates us from the star. Now light travels very fast—so fast that it could make a journey around the earth in less than a seventh of a second. In a minute, light travels more than 11,000,000 miles. Yet to reach us from the nearest star outside the sun, the light of the star must travel for more than four years! Adopting as his unit of distance the amount of travel of a pulse of light in one year, the astronomer says that the nearest star, whose name is Proxima Centauri, is a little more than four light-years distant.

For most of the people living in the Northern Hemisphere, the star Proxima is not visible; it lies far south in the sky, and is even then not visible without a telescope. It stands very near another star, named Alpha Centauri, which is only slightly farther away from us. Alpha Centauri is one of the brightest stars in all the sky.

Alpha has an unfair advantage, however, because it is really a double star. With the naked eye, it appears to be a single star, but through a telescope it is seen at once to consist of two stars, very close together. At least, they appear to be close, but between them there is more space than between

TABLE OF APPROXIMATE STAR MAGNITUDES (APPARENT)

Achernar	0.6	Capella	0.21	Pollux	1.2
Alcor	4.0	Castor	1.6	Procyon	0.5
Aldebaran	1.1	Centauri(Alpha)	0.06	Regulus	1.3
Alpheraz	2.2	Centauri (Proxima)	11.5	Rigel	0.34
Altair	0.9	Deneb	1.3	Schedir	2.3
Antares	1.2	Denebola	2.2	Sirius (brightest star)	—1.6
Arcturus	0.24	Formalhaut	1.3	Spica	1.2
Bellatrix	1.7	Moon(Full)	—12.5	Sun	—26.7
Betelgeuse	0.5 to 1.1	Polaris	2.3 to 2.4	Vega	0.14
Canopus	—0.9				

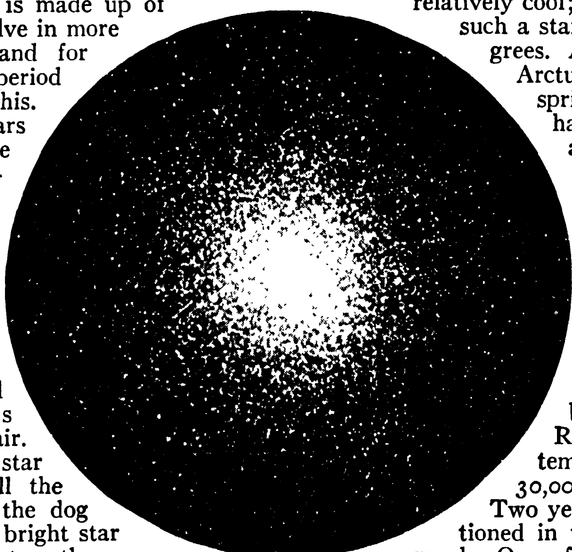
Stars may be arranged in six groups according to their brightness as they appear in the heavens. Stars in group one, or as we say, stars of the first magnitude, are brighter than stars of group two. Some stars may be so bright that they have to be put in a group of zero magnitude, or even of minus magnitude! Fractions are also used to tell the difference between stars in the same group. A star of the first magnitude is not six times brighter than one in the sixth magnitude, however. It is one hundred times brighter! This seemingly strange statement is true because the numerical system of indicating star magnitudes was decided upon long after the ancient astronomers had classified the stars by their own system. The newer mathematical classification permits the old-time groupings to remain almost the same, while at the same time permitting more accuracy in comparing brightness.

the sun and the planet Uranus, which is nineteen times as far from the sun as the earth is.

A double star, such as Alpha Centauri, is known as a binary star; the two stars really belong together. The two stars in Alpha Centauri revolve; they make one trip around the point between them in about 80 years. There are many such binary stars in the sky; one of them, the bright star Castor, one of the Twins, is made up of two stars that revolve in more than 300 years, and for some binaries the period is even longer than this.

Each of the stars that make up the binary Alpha Centauri is about half as bright as the sun! Together they are a little brighter than the sun. If the sun were as far away in space as Alpha Centauri, it would appear almost as bright as that pair.

The brightest star that we see in all the heavens is Sirius, the dog star. It is really a bright star —27 times as bright as the sun— and it is fairly close to us, only about nine light-years away. Sirius, too, is a binary; one of the stars is 10,000 times as bright as the other. This is one of the most interesting pairs in all the sky, because the fainter of the two stars is what is known as a white dwarf, a white star of enormous density.



Harvard Observatory

A great ball of stars, the globular cluster Omega Centauri, containing at least 100,000 stars, many of them bigger and brighter than our sun. It is one of the nearer of the 100 known clusters of this type—about 20,000 light-years distant.

Most stars have densities approximately equal to that of water; that means that a globe of water as big as the star would weigh about the same amount as the star. But this small companion of the dog star Sirius has a density many thousands of times that of water. Indeed we do not know any material on earth as dense as the highly compressed gas of which this star is made.

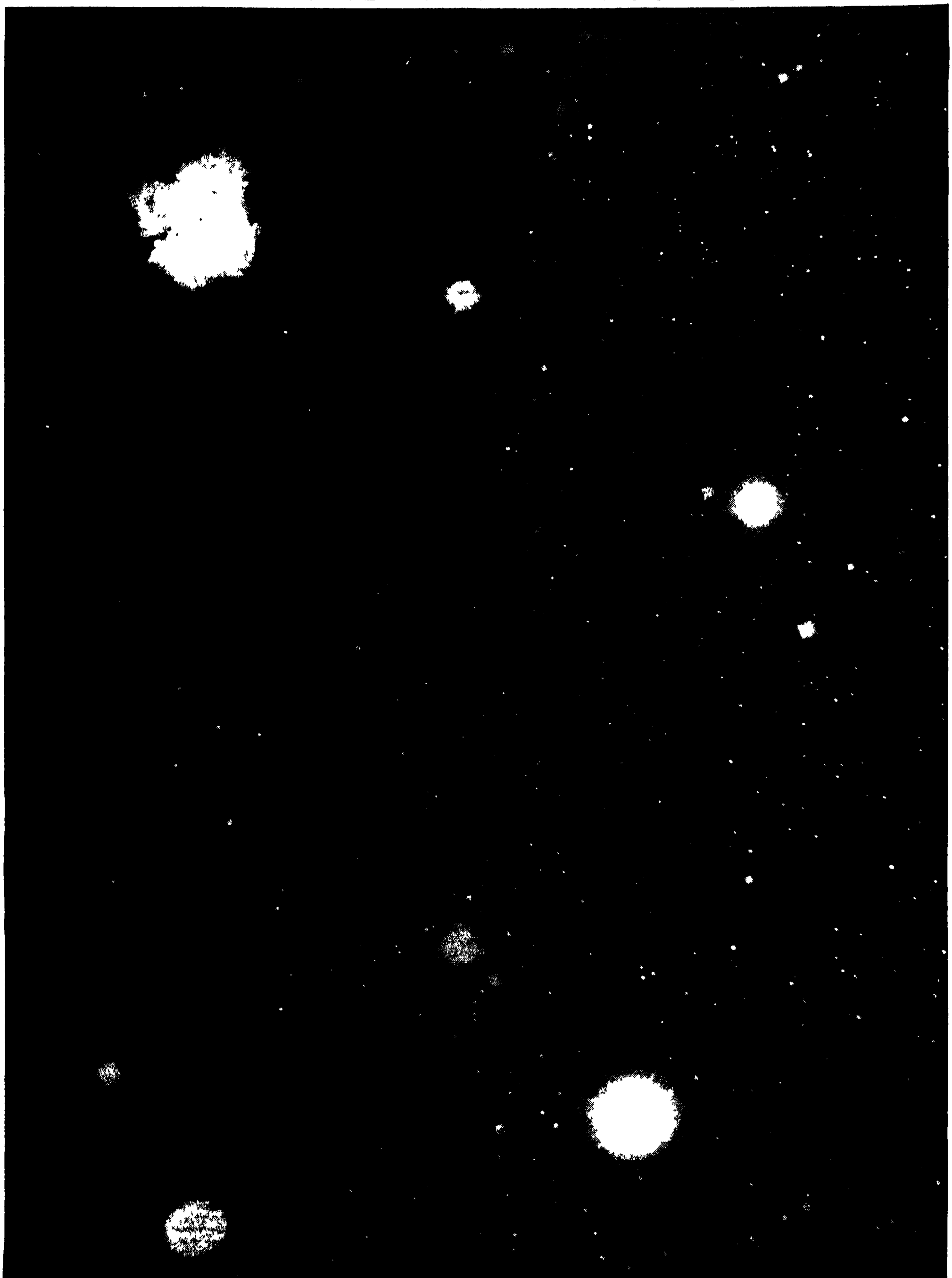
The color of this unusual star is white, as we have said. There are many white stars, and there are also blue-white ones, and yellow ones (like the sun) and orange ones and red ones. These different colors are due to different temperatures. Most people know that when a piece of metal gets hot, it glows and gives out light as well as heat. At first, it gives off a deep red light, but as it gets hotter, the deep red becomes bright red, then orange, then yellow, then white. So a very hot star is a white or blue-white one, a cooler one is yellow, a still cooler one is orange and the very coolest ones are red.

In the winter sky, the bright star Betelgeuse is a red one, so we can know it is relatively cool; the temperature of such a star is about 5,000 degrees. An orange star like Arcturus, that we see in spring and summer, has a temperature of about 7,500 degrees. A yellow star like the sun or bright Capella in the winter sky is at about 10,000 degrees. Almost 20,000 degrees is the temperature of a white star like Sirius or Vega; a blue-white star like Rigel in Orion is at a temperature of about 30,000 degrees.

Two yellow stars are mentioned in the preceding paragraph. One of them, the sun, we know pretty well; the other one, Capella, is among the brightest stars, yet it is very far away, and we know that it is really about 100 times as bright as the sun. It is a giant, while the sun is a dwarf. These terms, giant and dwarf, were at first intended by astronomers to indicate only that one star gives off much more light than another, but now we know that one must be a giant in size as compared with the other.

How can we know? Well, two stars with the same temperature give off the same amount of energy per square inch of their surfaces. Now if one of them is much larger than the other, there are more square inches shining, so the larger star will appear to be the brighter. Capella is about 100 times as bright as the sun, yet its temperature is the same. So Capella must have 100 times as much surface as the sun, or its diameter must be about ten times as great. Capella, then, is a gigantic star as compared with the sun.

THE HORSEHEAD NEBULA IN ORION



Mount Wilson Observatory

Not all the gaseous nebulae are bright. Above is a dark one in Orion, called from its shape, the Horsehead. Astronomers think such nebulae are dark because there are no stars nearby to set them shining.

The star Betelgeuse is a giant; its diameter is 300 times that of the sun! The earth's diameter is about $\frac{1}{100}$ that of the sun; yet the sun's diameter is only $\frac{1}{300}$ that of Betelgeuse! That star is certainly a giant, but there are others even bigger. The largest one known at present is not even visible to the unaided eye. It is one component (one of the stars) of the binary star Epsilon Aurigae; its diameter is about ten times that of Betelguese!

But these great giants are freaks; they are not so numerous as the dwarf stars. There are a million stars like the sun for every star as bright and big as Betelgeuse; there are many, many more millions of stars fainter than the sun for every one like one of these giants. We need not be ashamed of our sun; there are more stars fainter than it is than there are stars brighter than it is.

Since the stars are so far apart in the vast empty void of space, we might expect a great variety in their materials. At least, at first thought we should not imagine that the same stuff is in the stars as we find here on the earth. Indeed, we might think it useless to guess about what the stars are made of, for they are so far away that we can not hope to have a sample to examine and analyze.

We do not need a sample, however, if we will use a marvelous instrument known as the spectroscope. We have all seen how a prism of glass—a wedge-shaped piece—will break up sunlight into a rainbow band of color. This spread-out colored band of light is called the spectrum; deepest red is at one end, deepest violet is at the other, and in regular order between these limits we see orange, yellow, green, blue and indigo.

In a spectroscope, a prism is used to spread out the light from a candle flame, or an electric spark, or a star. In our laboratory, we find that the spectrum given off by a flame of glowing hydrogen is one thing, while the spectrum of glowing calcium is something else. Each material yields a different spectrum, characteristic of it alone. Just as no two people have the same fingerprints, so no two chemical elements have the same pattern in their spectra. Wherever we find a certain pattern in the spectrum, we can know that a certain chemical element is present.

When we analyze the light of any star, we find in it only familiar patterns that we know from our work in laboratories on the earth. We discover that the stars are made of hydrogen, carbon, iron, phosphorus, calcium, oxygen and many other elements that we know here on the earth. We do not find anything new in the stars, only those materials that make up the earth and everything in it and on it.

Sometimes, when people hear how far away the stars are and how big, they feel very small and helpless and unimportant, as unimportant as a handful of dust. Well, we know what the stars are made of, and many of those materials are the very ones that make up the human body. So, if we are dust, at least we know that we are star dust.

HOW THE STARS ARE ARRANGED

When we look into the sky, we do not see that the stars are at various distances from us. Some of them appear brighter than others, but these may not be nearer; they may be really very much brighter than the others and yet be farther away.

It might seem at first quite impossible to measure the distances of the stars, but in 1838 several astronomers discovered how to do it. We can understand how they did it if we perform a simple experiment.

Hold up a finger in front of your face. Now, with the left eye closed, look at the finger with only the right eye. Be sure not to move the finger. Notice how it seems to be lined up with things across the room. Now open the left eye and close the right one and you will see that the finger appears to stand in a new direction. If you did not move the finger, you know it must be just where it was before, yet it appears to have jumped from one position to another as you look first with one eye, then with the other.

You may be wondering what this has to do with the distance of a star. The earth revolves around the sun once each year. In January we stand on one side of the sun, in July we are far over on the other side of the sun. We can see a near-by star from two positions widely separated, and it will appear to stand first in one direction, then in another, as we view it first from one position, then from another. If a star appears thus to shift in position (as your finger seemed to shift), we know it is nearer than the stars in the background to which we refer it.

This experiment can be carried a little further. Hold the finger up close to your face and look at it first with one eye then the other; the finger will appear to make a big jump. If the finger is held up at arm's length, as far from the face as possible, it appears to shift much less. Just so, distant stars appear to shift far less than those near by.

By this kind of observation, the distances of several thousands of stars have been measured. The nearest one is said to be about four light-years distant from us; this means that it is so far away that the light that left there about four years ago is only now reaching the earth. A light-year is almost 6,000,000,000,000 miles!

Some of the stars we see at night—any night—are hundreds of light-years distant. With telescopes we see fainter and more distant ones. We find them in pairs sometimes, as we have told you—two stars revolving around each other in periods that range from a few years to several centuries.

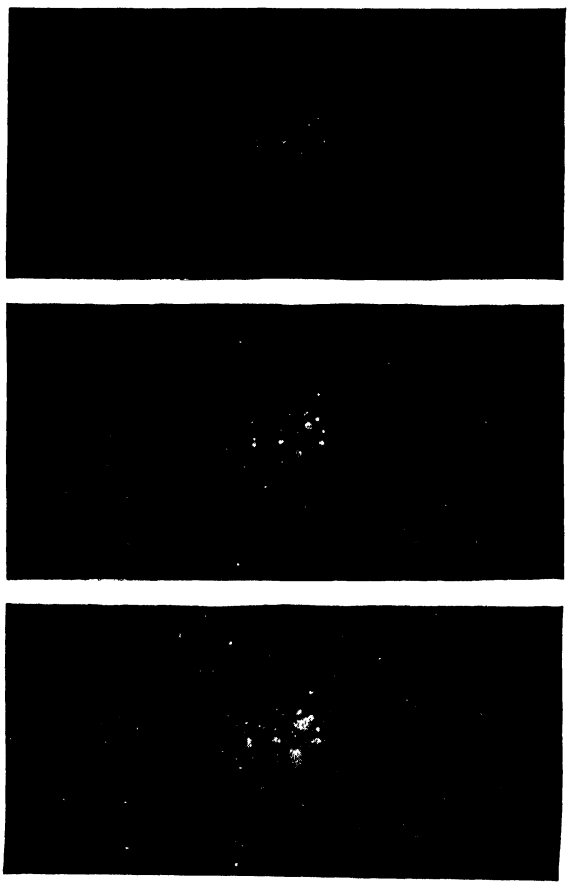
In the direction of the Milky Way, the stars are very numerous. The Milky Way consists of almost countless millions of stars too far away from us, hence too faint to be picked out individually without the use of a large telescope. As we begin counting stars in the part of the sky where the Milky Way does not pass, we find certain numbers of them; as we count in the regions nearer the Milky Way, the numbers are greater. Right in the middle line of the Milky Way, the numbers are greatest.

One other important matter is that the number of very faint stars in the direction of the Milky Way is very great. While it is true that we can not judge just by the apparent brightness of a star whether it is a near-by one or a distant one, when we deal with a great many stars we can say that, on the average, the faint stars are distant ones. So if we find many faint stars in the Milky Way we can say that there are many distant stars there. The stars extend to greater distances in the direction of the Milky Way.

The Milky Way extends as a belt or band all the way around the sky. In some parts it is very thin, as in the part that stands almost overhead on January evenings. Other parts, as those close to the horizon in July evenings, are very rich and bright.

Out of all these star counts, we have been able to build up a picture of the system of stars in which we live. We call it the Milky Way System, or Milky Way Galaxy. It is shaped somewhat like a bun, or a cookie. It is thin and it is made up of a tremendous number of stars. To tell the number of stars by direct counting of all of them would take us many lifetimes, so what we must do is to take samples here and there all over the sky, then make allowance for the parts of the sky where we have not counted. As a result, we believe there are at least 100,000,000,000 stars in our Galaxy.

We do not live in the middle of this Milky Way Galaxy; we are more than halfway from the center toward



Cook Observatory of the University of Pennsylvania
The camera aids our study of the stars. Pictures of the Pleiades, taken with exposures of ten minutes, thirty minutes and ninety minutes. See how the longest exposure brings out details.

one edge. When we look toward the center, we see the very most stars. This is the direction of the constellation Sagittarius and the tail of Scorpius, close to the southern horizon in July. That is why that part of the Milky Way appears so bright.

When we look in the opposite direction, away from the center, we see many stars, but not so many as in the center direction; this is the thin part of the Milky Way overhead in winter.

LOOKING THROUGH THE THIN PART OF THE "COOKIE" OF STARS

When we look up or down through the thin part of the "cookie," we see the part of the sky where there is no Milky Way. There is not such a thick layer of stars there, so we do not see so many.

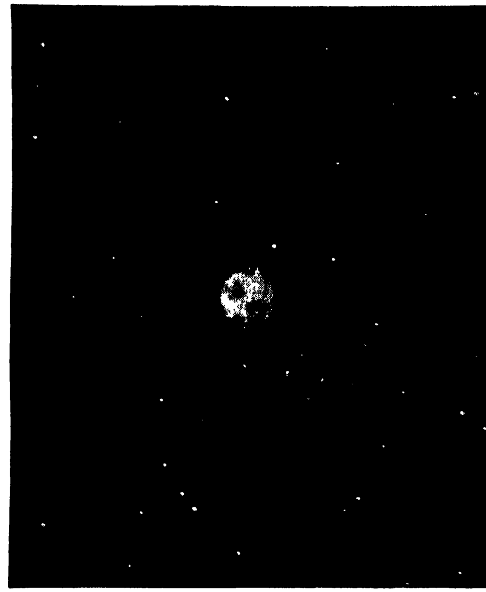
This whole system of stars is very large. The distance from one rim to the other is 100,000 light-years; we are about 30,000 light-years from the center.

Outside, there is empty space; inside, there is much empty space, too, for there is much space between any two of the stars. If you can imagine one tiny mote of dust in the center of an average-sized room, this will be about like the average star in the space it has for itself. One of these stars, remember, is the sun, the particular star around which the earth, the other planets and the comets all revolve. From outside our Galaxy, the sun would be quite indistinguishable from millions of others like it.

Far off among the stars, we find not only pairs, but even clusters of dozens or hundreds of stars. There are two kinds of these. One kind is found principally in the Milky Way, so it is called the galactic cluster. We might better call it a loose, or open, cluster, for the stars are loosely assembled with no apparent regularity. The other kind of cluster is called the globular star cluster, because it is more regular and roughly spherical in shape. These are magnificent objects containing scores of thousands of stars.

There are perhaps 300 galactic or open star clusters, but only 100 globular clusters. If the earth were revolving around a star near the heart of one of these fine objects, there would be dozens of stars in the sky far brighter than the brightest we see now. There would be many more people interested in astronomy, with such brilliant night skies.

One of the best-known loose star clusters is the little winter group called the Pleiades, or Seven Sisters. Only six stars are seen with the naked eye, but a moderate telescope shows 200 or more. When the cluster is photographed through a telescope, we see that Tennyson was quite correct when he said, in LOCKSLEY HALL,



Lick Observatory

The Owl Nebula in the Great Bear constellation.

> "Many a night I saw the Pleiads, rising through the mellow shade,
> Glitter like a swarm of fire-flies tangled in a silver braid."

The stars of the Pleiades appear to be all tangled up with sheets and swirls of gaseous stuff; this is called a nebula. The plural of nebula is nebulae.

Some nebulae, like the one of the Pleiades, shine simply by reflection. Such nebulae consist of mingled dust and gases and, like fog around a street light, the thin stuff shines by scattered and reflected starlight.

Other nebulae, like the magnificent one in the sword of the great hunter Orion, shine by a process called fluorescence. In this case the gaseous stuff is near very hot stars that emit much ultraviolet light. The gases absorb that ultraviolet and digest it, then give it out in different form—as visible light.

These nebulae are strewn all through the Milky Way and even elsewhere in the sky. Some of them take very interesting forms; there is the Owl Nebula, the Dumbbell, the North America Nebula, the Pelican and

many others. Some are merely sheets of filmy stuff mingled with the stars.

Here and there the stars seem to be almost absent and, when Sir William Herschel saw such a starless region, he lapsed suddenly into his native German and exclaimed, "*Hier ist wahrhaftig ein Loch im Himmel!*" (Here is surely a hole in the sky!). For a long time, these dark patches were thought truly to be regions where the stars thinned out, but today we know they are, instead, regions where dark nebulae hide the stars from view.

A dark nebula consists also of dust and gases which for some reason are not shining. Maybe they lie far away from any stars that would make them shine. They are like clouds of dust here on the earth; they hide the things behind them. Many of the stars are dimmed, if not completely hidden, by this cosmic dust.

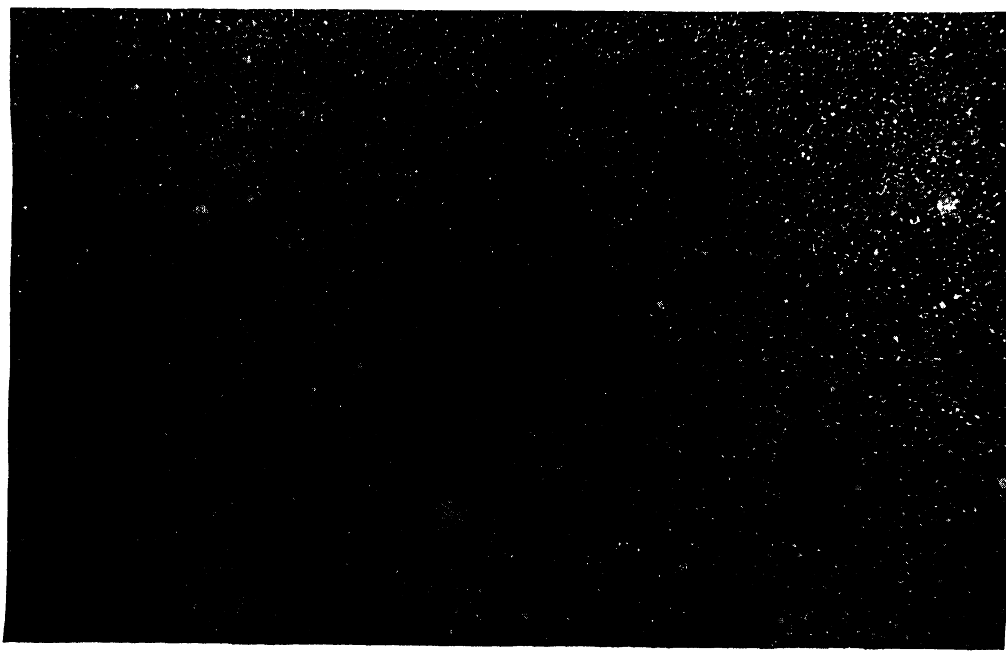
From the amount of this dust that we can see, we are able to estimate that there is really no empty space in our Galaxy; there are these particles strewn everywhere between the stars, here and there so densely that the stars are hidden. By the same observations, we have found that this dust and gas, thin as it is, amounts to as much in mass as the stars themselves. In other words, only half the total amount of matter in our Galaxy is collected into stars, planets and comets; the other half is this unorganized material of the cosmic fog between the stars.

This whole system, stars and dust and all, is rotating, but not like a wheel. The inside portions travel around in a shorter time than the outside portion. Out where we are, the speed is pretty high; the sun's speed is about 175 miles per second, and of course the sun's planets move along as it moves. But the trip around is a very long one; remember that the distance of the sun from the center of the Galaxy is about 30,000 light-years. It takes us about 225,000,000 years to make one trip around the center. Naturally, we have not been making observations that long, so our figures may be wrong by a few million years, one way or the other, but not by enough to make much difference.

Beyond the Galaxy lies more space, perhaps with a little dust and gas in it, and then there come other galaxies—other great groups of stars like ours. The universe is made up of galaxies, and one of them is ours. Our Galaxy is made up of stars, and one of them is ours, and we call it the sun. Many planets revolve around the sun and one of them is ours, the earth.

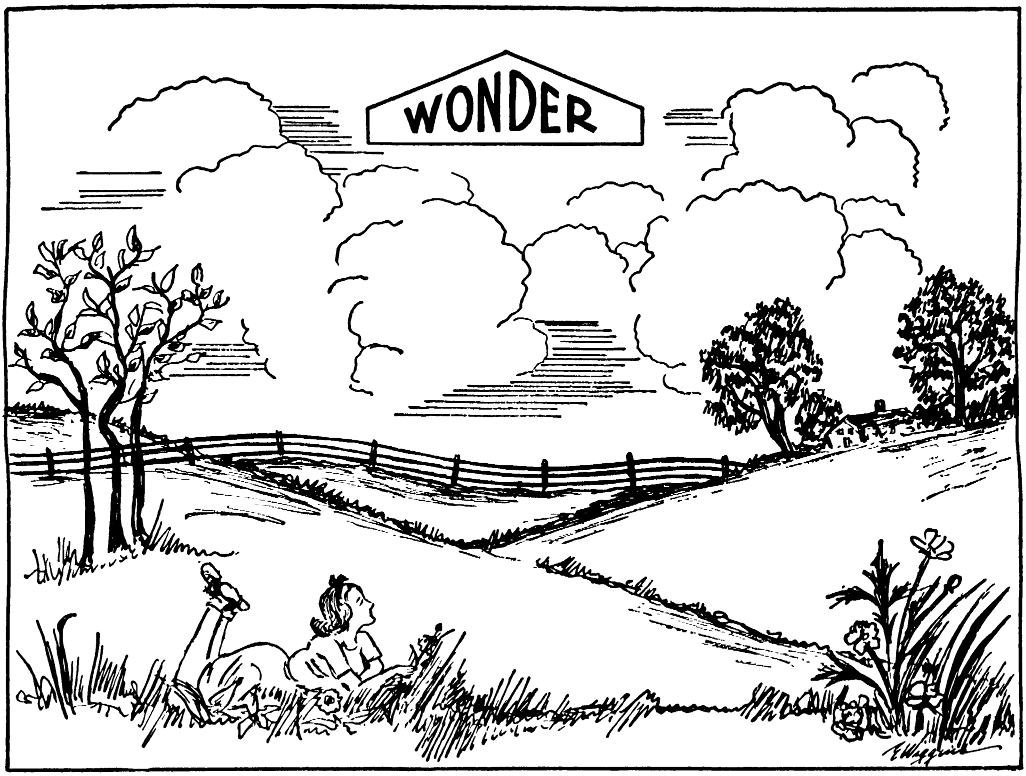
By Roy K. Marshall.

THE NEXT STORY OF THE EARTH IS ON PAGE 3921.



Mount Wilson Observatory

A dark nebula shaped like the letter S. Dark nebulae hide from us the light of stars behind them.



WHY IS THE SKY BLUE?

THE sky appears blue to us because the light from the sun is broken up and scattered by the tiny particles of air, dust and water vapor in the atmosphere. Sunlight, like all white light, is made up of all the colors of the spectrum, the same colors we see in the rainbow. If you were to take rays of light of all these different colors, and mix them, you would have white light.

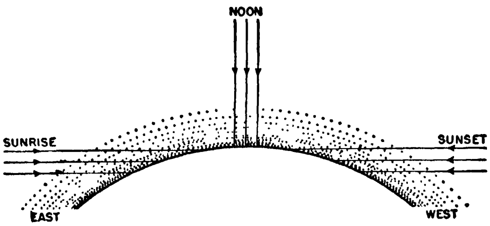
There is much that we have still to learn about light. We are fairly certain that it has a wave-like nature—in other words, waves of light spread out, something like the ripples you see spreading through a pool when you have thrown a stone into the water. Light of different colors moves in waves of different lengths. The waves of blue light are much shorter than those of red or orange light.

When the light of the sun passes through the earth's atmosphere and strikes against the tiny particles in the air, the blue part of the light is of just the right wave-length to be scattered by these particles. The red and orange light, having longer wave-lengths, pass right through the atmosphere. The scattering of the blue light makes the sky look blue. Also, because it is scattered in the sky, it does not come through to our eyes as part of the color of the sun itself. For this reason, the sun looks much yellower to us than it really is, because the blue light has been left behind in the sky itself.

In the morning and in the evening, at sunrise and sunset, however, you have often noticed the beautiful reds and oranges of the sky. At these times, the light of the sun passes through a greater layer of atmosphere than it does at other times of the day. It strikes more of the dust particles near the surface of the earth and then the red and orange waves of light are broken up.

Most of the color of any kind that we see in the sky is caused by the atmosphere. If there were no atmosphere, the sky would always appear a very deep black. Without any atmosphere, however, there would still be some color in the heavens. The stars that

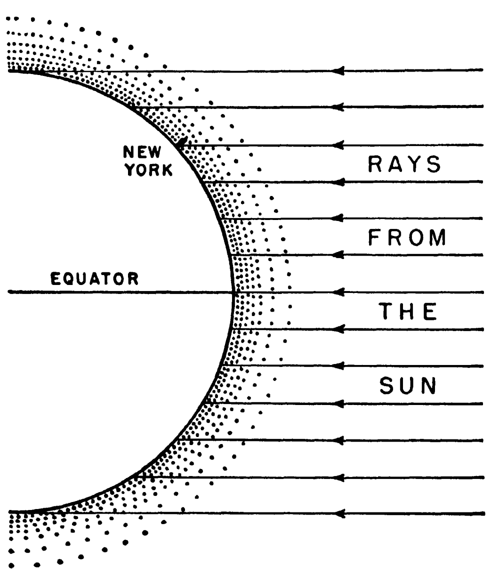
are blue or red or yellow—any color—would still keep their same colors, since these colors are not in any way due to the effects of the atmosphere of the earth.



At noon, the rays of the sun pass through a thinner layer of atmosphere than at sunrise or sunset.

WHY IS THE SKY SO BLUE IN TROPICAL COUNTRIES?

As we have seen, blue skies are always caused by the scattering of the blue light that is part of sunlight. The skies over tropical countries are bluer than in other parts of the world because there the sun is higher in the sky than in other places. The higher the sun is, the thinner the layer of atmosphere through which it has to pass. When the sun passes through less of the atmosphere—when its rays strike the earth more directly—it is the blue rays of sunlight which are scattered most. When the sun is lower, as it is at sunrise and sunset, the greater amount of atmosphere through which it must pass at those times scatters rays of other colors. Over any part of the world the blueness of the sky extends upward only a few miles. At a height of thirteen miles above the earth, the sky appears almost black.



At the equator, the rays of the sun strike the earth more directly than at any other latitude.

COULD THE SKY FALL DOWN?

The sky could not fall down, because what we call the sky is really just space—the space of the universe through which the earth, the moon, the sun and all the countless numbers of stars are traveling. The sky does appear to some people to be a great bowl turned upside down over the earth. If it were really a great dome, we should indeed wonder what held it up and fear lest it should crash upon us.

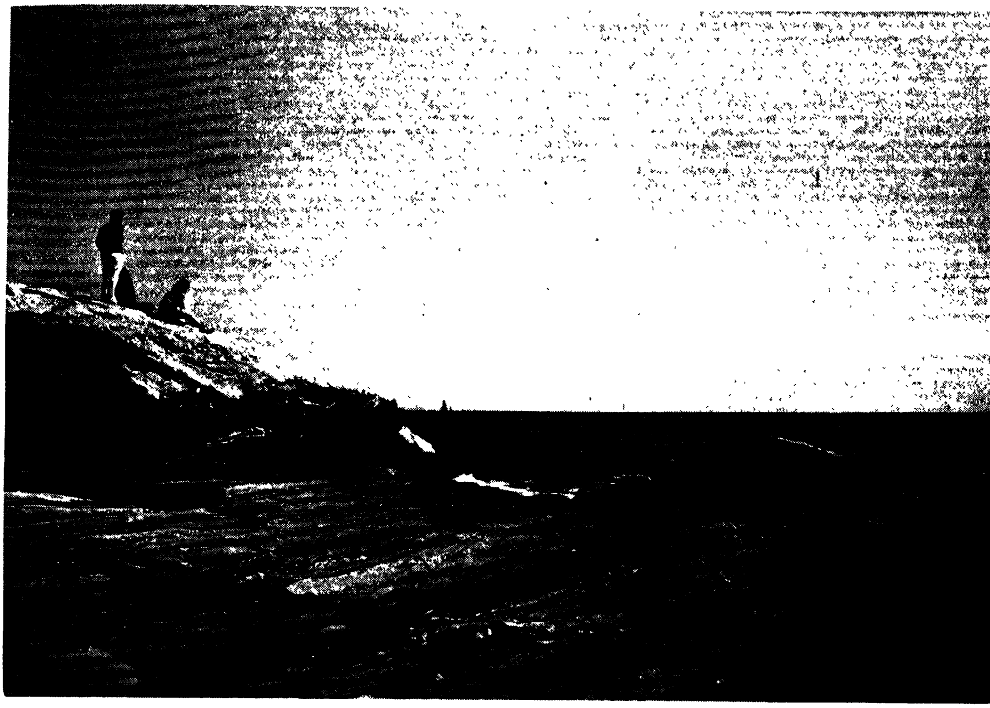
Several thousand years ago many people believed that the sky was a great crystal sphere, or a series of spheres, which revolved around the earth, carrying on their surfaces the heavenly bodies.

DO WE KNOW HOW FAR THE SKY GOES?

When we speak of the sky, we usually mean the vault of the heavens, or the great arch which seems to lie like an inverted bowl over the earth. We say that the sky is blue, that there are thunder clouds in the sky or that the sky looks stormy or clear. In this sense we mean the nearer sky, the atmosphere, in which our weather and all our sunset and sunrise colors occur. This is not all of the sky, however, even though it is now believed that the atmosphere stretches up to a height of probably 600 miles above the earth.

Beyond that part of the sky that takes on color and that we see changing from moment to moment, lies the great universe of space. We look out through the atmosphere to that greater sky beyond, where the planets, the stars and the galaxies move majestically upon their paths. This sky universe is so vast that no one knows where it begins or ends. We do not even know whether it has a beginning or an end.

Astronomers, using their great telescopes, have not yet found any end to the multitudes of stars out there. With each new and larger telescope they have been able to see farther out into the universe. The distances are so great that they do not measure them in terms of miles, any more than we measure the distance around the world in inches.



Maine Development Commission

Astronomers use the light-year—the distance light travels in one year—as their yardstick. This great measuring rod is a long one—6,000,000,000,000 miles long.

With the 100-inch telescope at Mount Wilson, California, astronomers have photographed objects which are 240,000,000 light-years away—240,000,000 times 6,000,000,000,000 miles. We know, then, that the sky extends at least that far in all directions from the earth. With the new giant telescope on Palomar Mountain we shall perhaps be able to explore the sky as far as 6,000,000,000,000,000,000,000 miles on all sides of the earth. Whether we shall find that the stars grow fewer in number when we get so far away, or perhaps that there are no more stars out there, only time can tell.

HOW MANY STARS ARE THERE IN THE SKY?

No one knows how many stars there are in the whole sky. No one knows, either, how far the sky extends in all directions away from the earth. This is, of course, the same thing as saying that no one knows how large the universe is. With each new telescope larger than the last, astronomers have continued to see to greater distances. As we penetrate farther into space, we see more distant stars. Some astronomers, however, believe that we may in time—through bigger and bigger telescopes—reach a region where there are no stars. Other astronomers see no reason why there may not be stars stretching endlessly in all directions. For most of us it is equally difficult to imagine an end to space or to imagine space, filled with stars, which goes on endlessly and forever. There is even a theory that space may be curved.

In our own Milky Way Galaxy—the system of stars to which our sun belongs—there are many billions of stars. With the 100-inch telescope at Mount Wilson Observatory we have already observed about 500,000,000 galaxies which seem to be much like the Milky Way Galaxy. It seems probable that most of these contain about the same number of stars as are found in the Milky Way system. The 200-inch telescope on Palomar Mountain penetrates more than twice as far as does the 100-inch telescope. After further researches with this great instrument, we may just possibly know better how to answer the question—How many stars are there in the sky?

WHY DO WE NOT SEE THE STARS IN THE DAYTIME?

In the early days, before men understood much about the heavens and the science of astronomy, many people believed that the stars actually ceased to shine during the daytime. The ancient Egyptians believed that they were lanterns lighted each night by the gods, so that the sky would be more beautiful. They thought that the gods let these lanterns down on cables through the holes in the sky, and in the morning pulled them up again and put them out.

The stars are shining all the time, day and night. We do not see them in the daytime because of the atmosphere around the earth which breaks up and scatters the sunlight into a blanket of brightness through which we can not see. We can see through the atmosphere at night, out to the stars, because then there is no scattered sunlight. If there were no atmosphere, we could see the stars in the daytime as well as at night. The sun would appear simply as a clearly defined disc of light in a black sky pierced by many thousands of brilliant stars.

During a total eclipse of the sun, we can see the brighter stars and whichever planets happen to be in the sky at the time. When Venus, the brightest of the planets, is at its most brilliant, it can be seen in the daytime sky if one knows where to look for it. It is also true that if one could climb high enough in an airplane to get above the main part of the atmosphere, the stars would be visible at any time. The phrase "by starlight" would mean both night and day.

Even at night, of course, the stars are often hidden from our sight. Clouds hide them very effectively, as do fog and mist. After traveling untold distances through space, the rays of light from the stars may at the very end of their journey be hidden from our sight by a thin curtain of clouds above us.

Above the clouds or out through the halo of light that surrounds the earth, the stars are always shining. Day and night, in moonlight and sunlight, clear or stormy weather, they circle constantly high around the earth.

ARE THERE ANY DIAMONDS IN THE SKY?

Diamonds are sometimes found in meteorites which, before they came to rest upon the earth, were certainly in the sky. In that sense, we could say that there are diamonds in the sky. The diamonds found in meteorites, however, are not worth anything commercially although they are of great interest to the scientist. They are usually very small and of not very good quality.

We do not know very much about the manner in which diamonds found on earth are formed, but we believe that they were once carbon in the earth's crust. This carbon apparently crystallized into the form which we call diamond. This change probably occurred because of the enormous heat and pressure in the earth's crust. Perhaps it is in this same way that the diamonds in meteorites have formed, for meteorites, too, were once under intense heat and pressure.

IS A FALLING STAR ONE OF THE STARS WE SEE IN THE SKY?

The real stars do not fall and shoot across the sky. They are, indeed, moving very rapidly through space, but they are so far away from us that we do not notice that motion except over very long periods of time.

The objects which we call "shooting" or "falling" stars are not stars at all, but meteors. These bodies are chunks of stone or metal. When they land upon the earth, as some of them do, we call them meteorites. No one knows just where they come from. Perhaps some of them are pieces of comets that have been destroyed on their long trips around the sun. They may be bits left over from the formation of the solar system which have, like the planets, gradually cooled and hardened from the hot, gaseous masses they once were. They may even have come from the great unknown vast spaces between the stars in our Milky Way, or even from farther away than that.

As meteors approach the earth, their speed is increased by the earth's strong pull upon them. Friction against the particles of the earth's atmosphere causes them to become heated on the outside. This heating causes the hard black crust which we so often find on meteorites. Most meteors, however, are burned up by the intense friction and reduced to ash or gas before they reach the surface of the earth. Some of the dust in the higher layers of the atmosphere is the ash of meteors.

We see only a few of the billions of falling stars that plunge through our atmosphere every twenty-four hours. We rarely, of course, see those that fall in the daytime because of the light of the sun. Of the meteorites that land on the earth's surface we probably find less than one in a hundred.

As the earth sweeps along on its path around the sun, it gathers to itself more and more of these tiny particles. Probably each year the earth's mass is increased by several hundred tons of meteoric dust and ash, some of which sifts gradually down to the surface of the earth.

WHY ARE THERE MORE STARS SOME NIGHTS THAN OTHERS?

At different seasons of the year we do not see the same parts of the sky, and certain sections of the heavens are richer in stars than other parts. It is also true that not all parts of the sky contain equally brilliant stars. Because of this, we sometimes notice that the stars appear particularly numerous or especially brilliant.

Sometimes, too, we see more stars than we do at other times because of changes in the earth's atmosphere. These changes may be quite apart from the presence of actual clouds in the sky. Even when there are no clouds in the sky, we can sometimes see only the brighter stars, while the fainter naked-eye stars are invisible. At such times the air may contain more dust and water vapor than at other times. These particles make a kind of curtain through which we can see only the brighter stars.

Where it is possible, observatories are built on high mountains, so that less of the heavy atmosphere of the earth will come between the telescope and the stars. The thickest part of the atmosphere is the part nearest the earth. Observatories are usually built, also, in parts of the world especially chosen for the clearness of their climate.

HOW MANY STARS CAN WE SEE WITHOUT USING A TELESCOPE?

Most people imagine that with the naked eye they can see millions of stars in the sky when it is clear. Actually, there are in the whole sky only about 9,000 stars visible to a person with especially good eyesight. We have to remember, however, that we do not see all of the sky at any one time, but only about half of it. Because of mists and haze near the horizon, usually less than half of the 9,000 naked-eye stars are visible at any one time. The number we see on a clear night is probably somewhat less than 4,000 stars, even under the best possible seeing conditions, away from smoke and dust.

AMONG THE MANY STARS ARE THERE WORLDS LIKE OURS?

Many astronomers believe that there are probably other families of planets like our own solar system. It seems very likely that if our sun, which is just an ordinary star, has planets moving around it, other stars may have planet families, too. Astronomers have not been able to prove this, however, since even the biggest telescopes are not large enough to show other planets which might be revolving around other stars.

In our own solar system there are eight other worlds somewhat like the earth. The earth is probably the only one, however, on which living creatures are to be found. For many years astronomers have wondered about life on Mars, our red neighbor planet. Now, because Mars has so little atmosphere and water, we know that there are probably no human beings or other living creatures there. Recently astronomers have come to believe that certain kinds of plants do grow on Mars. The other planets of our solar system are not suitable for living beings.

WHAT HOLDS THE STARS IN THEIR PLACES?

The stars are not held in their places, if by that we mean held in one position. All the stars—in fact, everything in the universe, asteroids, stars, galaxies of stars—all are moving through space at unbelievable speeds of many miles a second. It is possible that

all these bodies move in definite paths or orbits. We know that planets, moons and asteroids do, but we do not yet know how the sun and the stars move. Their paths may be straight lines, ovals, circles, zigzags or spirals.

The great force of gravitation, which holds the planets in their paths around the sun and the moons in their paths around the planets, undoubtedly acts upon the stars as well. Each bit of matter in the universe pulls upon every other particle of matter. The paths along which the heavenly bodies move are very largely determined by this gravitational force. If one body comes too close to another body, the lesser is drawn into the greater and destroyed. On the other hand, the forces of gravity are no doubt responsible for the balance and state of equilibrium of the universe. We may say that forces of gravitation "hold the stars in their places."

WHY DO THE STARS TWINKLE?

When we look up at the stars on a clear night, those faraway pinpoints of light often seem to flicker and twinkle.

> Twinkle, twinkle, little star,
> How I wonder what you are,

runs the old rime which expresses what many boys and girls through centuries have wondered.

The stars themselves do not twinkle. If you could climb up above the atmosphere surrounding the earth and then look at the stars, you would see them shining with a clear and steady light, with no suspicion of twinkling. It is because we see the stars through the ocean of air, the atmosphere, that they seem to twinkle.

The twinkling is caused by differences in temperature in the air. Some layers of air are hotter than others, and one layer is always swirling and moving through another. These different layers of air bend the starlight in different ways, and at different angles. It is this passing through layers of air of different temperatures that makes the light of the stars unsteady. This unsteadi-

ness or twinkling is similar to the trembling we see when we look at things in the distance on a hot day or through the air over a steaming radiator.

If you have ever looked at the night sky carefully, you have noticed that the stars near the horizon seem to twinkle much more than those high in the sky. This is because the light of these stars has to travel a longer path through a thicker layer of atmosphere, and thus has more chance to become disturbed. You may have noticed, too, that sometimes the stars twinkle much more than they do at other times. This is true because at some times the atmosphere is not so still as it is at other times, or because there is not such a variation of temperature within its different layers.

Lovely as the twinkling of the stars is, it causes a great deal of trouble for astronomers. Even on clear nights they can not always make good observations through their great telescopes. The telescopes simply magnify further the twinkling effect, so that often the stars seem actually to be dancing and jumping around.

HOW CAN WE TELL A STAR FROM A PLANET?

Stars and planets look very much alike, although they are actually entirely different kinds of bodies. Stars are huge balls of extremely hot and glowing gas, like our own sun. The sun, of course, seems much larger and hotter than any of the other stars because it is so much closer to the earth than any of the others. Planets, on the other hand, are much smaller than most stars and more or less like the earth. They have no light or heat of their own. The planets shine brilliantly in the sky simply because they reflect the light of the sun, somewhat as a mirror might. While there are countless trillions of stars, we know definitely of only nine planets, and all of these belong to the sun's family.

On a clear night the sky is full of stars. Since the planets are constantly moving around the sun, some of these bodies may be in the night-time sky where we can see them among the stars, and some of them may be in the daytime sky where we can not see them because of the sunlight. At times when some of the planets are shining among the stars, it may be difficult to know which are planets and which are stars.

We have already seen that stars twinkle because their light is bent in various ways by the differently heated layers of atmosphere. Planets do not twinkle, ordinarily, but seem to shine with a steady, unwavering light. Even through large telescopes, the biggest stars appear simply as tiny points of light, while the planets show very definite discs and surfaces. Hence, more rays come to us from the surface of a planet than from the surface of a star. The light from the planets does not waver as much as that from the stars because the wavering of one ray of light is counteracted by the wavering of another ray in another direction.

Planets can also be picked out by noticing that over a period of time they change their positions against the background of the stars. The word planet means wanderer. Through the year, the planets can be seen traveling against the starry sky. The stars, on the other hand, seem to remain fixed in relation to each other.

WHAT ARE THE SIGNS OF THE ZODIAC?

Around the whole sphere of the sky there extends a particularly important band of stars. The stars in the band form, roughly, twelve groups, which men call constellations. (The word means star groups.) Centuries ago star-gazers thought all these groups except one looked like men or women or animals; and so they called the band the zodiac. Our word *zoo* comes from the same Greek source. The constellations of the zodiac are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius and Pisces. Through this narrow band of stars the planets, the moon and the sun take their way.

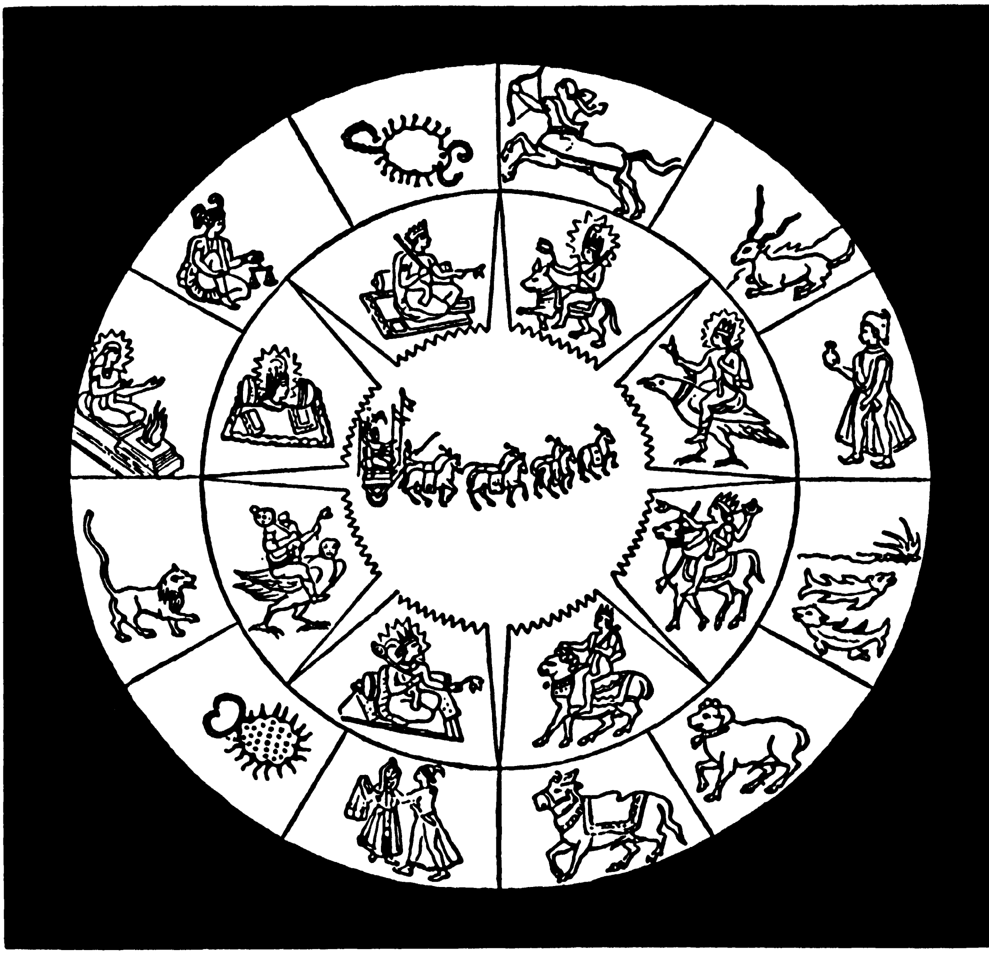
Some 2,000 years ago the great Greek astronomer Hipparchus made a chart, dividing the zodiac into twelve divisions which he called signs—and these signs had the same names as the constellations we know today. He had noted, as astronomers before him had noted, that the sun stays, roughly, in one of these divisions during one month of the year. When an astronomer in those days, and for some time later, said that the sun or a planet was in a particular sign, he meant that it was in a certain constellation. Actually he meant that it seemed to move against a certain group of stars, since the planets and the sun are much closer than any of the stars.

However, through the centuries since Hipparchus' time there have been changes in our sky. A peculiar, slow wobbling motion of the earth as it turns on its axis is constantly tilting the axis. Because of this the

north and south poles of the earth describe little circles on the sky over a period of 26,000 years. This changes the position of the constellations and seems to skew the sky around. We who are living now do not see the heavens from the same angle as Hipparchus did. The signs in his chart of the zodiac no longer coincide with our view of positions in the constellations which bear the same names.

Modern astronomers do not use the signs for reference in scientific astronomy although the signs are still used by those who believe in astrology.

The different peoples of the world have through the centuries developed their own



This ancient Hindu zodiac shows the chariot of the sun-god in the center, with the horses that were believed to pull it across the heavens each day, from east to west. In the section next to the center are eight of the Hindu constellations. In the outer row are the twelve signs of the Hindu zodiac, all of them similar to our own.

the constellations, which seem to slip westward. So the sign of Aries, the Ram, for instance, is no longer in the constellation of Aries, but in the constellation of Pisces, the Fishes, to the west of the constellation Aries. After the passage of 26,000 years the signs come back, more or less, to their original signs or symbols for the zodiac. The Chinese and the Egyptians, for instance, have different signs from ours. The twelve zodiacal signs of the Chinese are the rat, ox, tiger, hare, dragon, serpent, horse, sheep, monkey, hen, dog and pig. Most of the constellations are seen as animals.

Astrologers observing the heavenly bodies. This picture was probably done by Holbein in the sixteenth century.

WHAT IS ASTROLOGY?

Astrology was the parent or forerunner of modern astronomy. In early times astronomers believed that many different kinds of events could be foretold by the positions of the stars and the planets. This was only natural, since, in the days before they understood much about the calendar, people watched for the seasonal return of certain constellations to tell them when to plant their crops and when to expect rainy or windy seasons. This belief carried over into other fields, and soon it was a common belief that all kinds of human events could be predicted by observing the heavenly bodies. There are many people today who believe in astrology.

WHY ARE STARS OF DIFFERENT COLORS?

Some stars are yellow, like our sun; some are blue and some are white. There are even green, purple, rose and amethyst-colored stars. The color of a star depends very largely upon its temperature. The red stars are cooler than the yellow ones. The yellow stars are cooler than the white, and the white are cooler than the blue-white. If you have ever seen a blacksmith or a worker in metals heating a piece of iron, you know that at first the iron glows with a reddish color. As it becomes hotter, it changes to yellow, then white, and, if the temperature becomes very high, sometimes it takes on a bluish white color.

If you look carefully at the stars on a clear night, you may be able to discover the colors of some of them for yourself. Many stars appear white, but some show a definite tint of color. Sirius, the dog star in the constellation Canis Major, the Great Dog, is a white star, with a temperature of about 10,000° Centigrade. Capella, the bright star in the constellation Auriga, is a yellow star like the sun, and has a temperature of about 6,000°. Both Arcturus, in Bootes, and Aldebaran, in Taurus, are orange stars with temperatures of about 4,000° C. In the case of a double star, one star of the pair may be one color, and the other star, another.

DO STARS HAVE FIVE POINTS?

No. Stars in the sky are balls of gas—round—like our sun. We picture stars as symbols, sometimes, with five points, seven, or even nine. It is simply a convention to represent them this way. If you were to look at a star through a telescope, you would see that it looks like a point of light.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3838.

Courtesy, Better Vision Institute, Inc.

Sight is the strongest of our senses, and our eyes are probably the most precious of all our possessions.

THE EYE *and* SEEING

ALMOST all living things are sensitive to light. You know, for example, that a clam closes its shell when a shadow falls across it. This action is made possible by a number of special cells lining the edge of the shell. Light falling on these cells excites them. Nervous messages, or impulses, then pass to the muscles which close the shell; and we say a simple nervous reflex is completed.

But this sensitivity to light is quite a different thing from vision. A clam can not be said to see in the sense that a man can see. Before an animal can really see it must have two things. First, it must have eyes—true eyes, not the simple type found in a shellfish. Second, the eyes must be connected with a well-developed brain.

There are many animals with perfectly good eyes—quite as good as our own, in fact—yet which see very little. The explanation of this rather surprising fact is that such animals have well-developed eyes connected with brains that are still primitive. They can use their eyes and simple brains to react to light in a reflex fashion. But they can not really see, because there are no centers in their brains that control vision.

Thus, a fish may appear to prefer one type of bait to another. But it is most unlikely that it can actually see either of them. And, certainly, it can not make a conscious choice between them. This is so simply because the fish has no centers for vision.

The eyes of all higher animals are fundamentally similar. Each eye consists of a number of structures contained within an almost spherical body—the eyeball. Most of the eyeball is enclosed in a bony cavity at the front of the skull; only a little of it is visible from the outside. The eye is also partly hidden or surrounded by a variety of other structures—eyelids, tear glands and ducts, muscles, blood vessels and nerves, to

mention only a few. Each of these has a special part to play in making the eye an efficient working organ.

The eye is nearly always compared to a camera. Indeed, the two are very similar. In both, there is a sensitive screen on which the rays of light are focused. Both have a lens to do the focusing. Both have a dark inner coating to prevent reflection and blurring. And, finally, both the eye and the camera can be adjusted to give sharp pictures at different distances. In the case of the eye, this adjustment of the focus for objects at various distances is known as accommodation.

THE BRAIN CONTROLS THE MOTION OF OUR EYES THROUGH A SPECIAL SET OF MUSCLES

Eyes do not stay still. They are constantly moving, following objects, looking from place to place. Our eyes, and the eyes of other mammals, move together. Both of them are always directed toward the thing we wish to see. The delicate control of eye movements depends on nerve impulses from a special center in the brain. These messages cause the contraction of a set of six muscles which run between the eyeball and the bony wall which encases it. It is the contraction of one or more of these muscles which moves the eye.

The outer wall of the eyeball is made up of three layers: the fibrous layer, the pigmented layer and the retina.

The fibrous layer is the outermost, protective layer of the eyeball. It is thick and tough. Most of this layer is cloudy or opaque. (An object is opaque if you can not see through it.) But in the center of the exposed part of the eye, the fibrous layer becomes transparent and is called the cornea. Thus, the cornea is really a tiny window in an otherwise opaque layer. The rest of the exposed part of the fibrous layer is loosely referred to as the white of the eye.

The cornea and white of the eye are continually moistened and washed by the fluid from the tear glands. These glands, located beneath the lids at the outer corners of the eye, have this washing as their primary function. Other animals do not cry. Only man uses the tear glands for crying, as well as for washing the eyes.

The pigmented layer lies beneath the fibrous layer. All of its cells are crowded with tiny colored grains of pigment—hence its name. This dark layer corresponds to the black, inner surface of a camera, and it has the same function—to prevent reflections. The pigmented layer, of course, does not extend completely around the eyeball; it does not extend under the cornea. If it did, no light could pass into the eye.

The retina is the innermost of the three layers of the eyeball. It is the sensitive layer, the one which reacts when light enters the eye. Thus, it may be compared with the film on which one takes a picture with a camera. The retina is a cup-shaped structure lying in the back half of the eyeball.

This highly sensitive layer is made up of a large number of nerve cells. Some of these cells are connected with the brain by means of long strands of cytoplasm which extend out from their cell bodies. These long strands are nerve fibers. The fibers from the retina of each eye are all gathered together at the back of the eyeball. Then they pass to the brain in a single, large cable—the optic nerve.

As light enters the eye, it passes first through the clear cornea. This small circle of transparent tissue lies just in front of the pupil. As you can see by looking at your own eye in a mirror, the pupil is a small hole in the center of a ring of colored tissue. The colored tissue ring is the iris. When we say a person has blue eyes, or brown eyes, we really mean that his irises are blue or brown. Iris was the name of the rainbow goddess of the Greeks, and this is the source of the word.

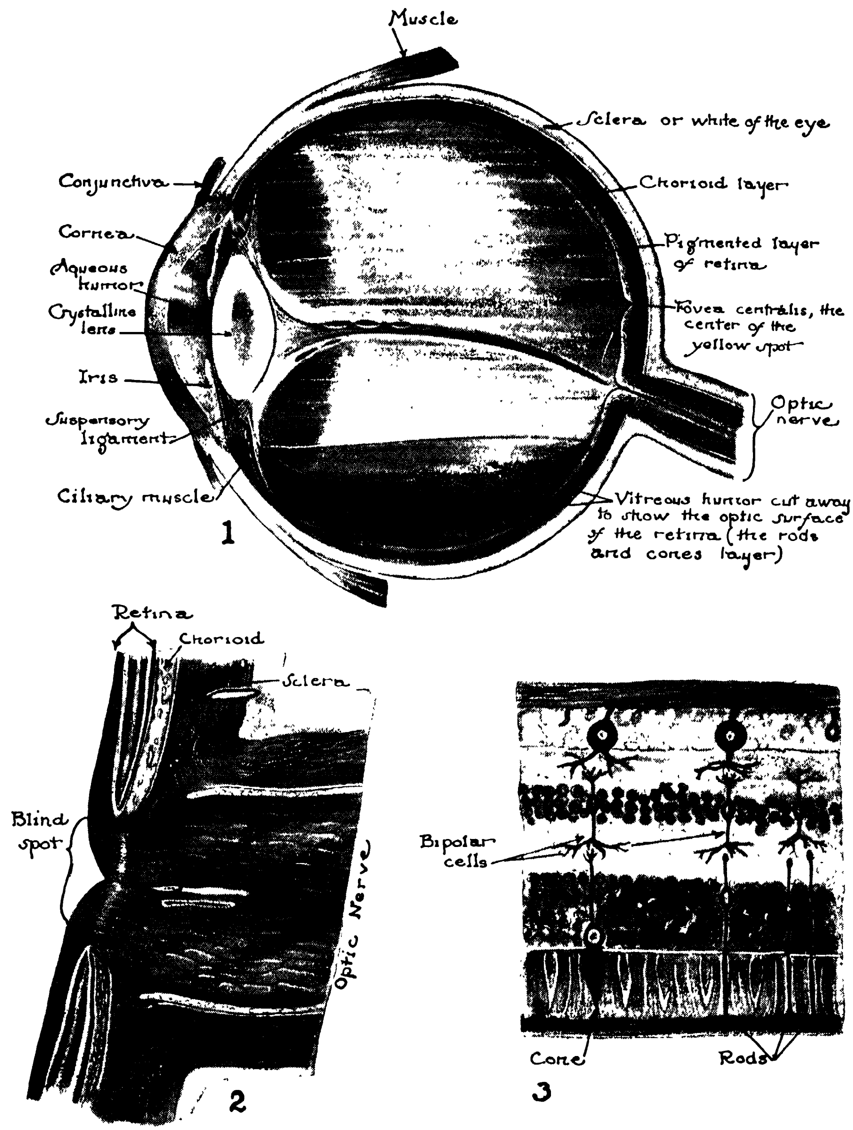
HOW THE QUANTITY OF LIGHT ADMITTED TO OUR EYES IS REGULATED

The amount of light which is admitted to the eye is controlled by two structures. The eyelids, for one, are opened wide or partly closed, depending on the brightness of the surroundings. An even more exact control, however, is provided by the iris. This tissue ring contains tiny muscle fibers which may either constrict (narrow) or dilate (widen) the pupil and thereby regulate the entering light.

In some lower animals, the shark, for instance, the muscles of the iris react directly to light-rays. But in higher forms the movements of the iris are controlled by nervous reflexes. These reflexes depend on fibers of the visceral nervous system. This makes it easier to understand why the iris reacts not only to changes in light intensity, but also to emotional changes. During fear, pain and anger, the pupil is dilated to admit more light. Under more normal conditions, the pupil narrows.

After light has passed through the pupil,

THE EYE IS THE CAMERA OF THE BRAIN

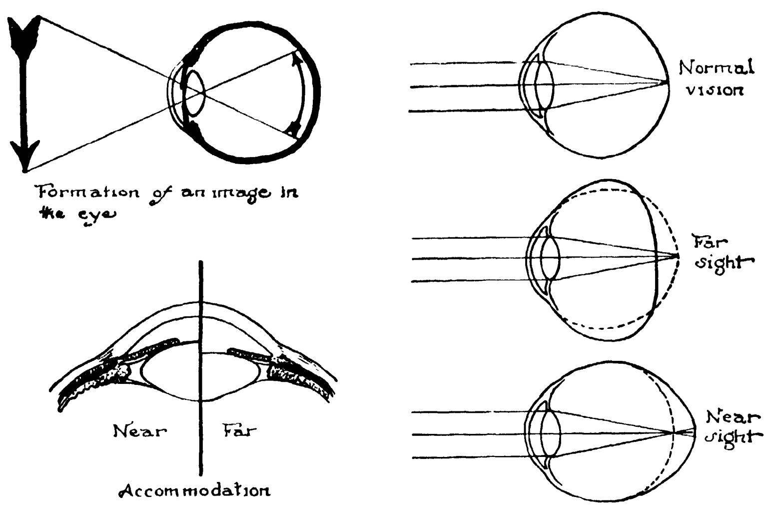


Number 1—A cross-section of the eyeball, showing the various structures. The eyeball and the optic nerve form the principal parts of the eye, but the sight system also includes the tear glands, the eyelids and the muscle apparatus. The normal eyeball is about one inch in diameter. Number 2—A magnified section of the area where the optic nerve leaves the eyeball to go to the brain. At this point there is a small "blind spot," where there is no sensation of vision, due to the absence of rods and cones. Number 3—A greatly enlarged view of the retina, showing its three layers—the rod and cone layer, which receives light impressions; the bipolar layer and the transmitting layer, which send these impressions to the brain through the optic nerve.

it next strikes the lens. Like the lens in a camera, the lens of the eye serves to bend the entering light-rays and bring them to a focus. In this way, an image is formed on the retina. If it were not for the fact that the light-rays are focused, we would see nothing but blurred, indistinct patterns of light and dark. The lens of the eye shares the job of focusing with the cornea. In a disease known as cataract, the normally transparent lens becomes clouded, and light can no longer pass through it. In such cases, blindness can be prevented by removing the lens surgically. When this is done, the cornea can do most of the work of focusing the light-rays, although often spectacles are also needed.

In shape, the lens of the eye resembles that of a magnifying glass. Its front and back surfaces are both curved outward—that is, they are convex. The two curved surfaces come together to form a narrow, circular border. Along this border, the lens is attached to a thin, circular membrane which extends outward to connect with the fibrous layer of the eyeball. This membrane holds in place, or suspends, the lens, and it is therefore called the suspensory membrane. At the point where the membrane joins the fibrous layer, a small, circular muscle is found. This is the ciliary muscle and, despite its small size, it is of tremendous importance in seeing.

As any amateur photographer knows, an image is brought into focus on the film in a camera by moving the lens away from the film for near objects and toward the film for distant objects. Many animals still employ this simple method of focusing. They have special muscles for moving their eye lenses forward or backward.



Top left—An image is upside down on the retina, but we "see" it rightside up. Bottom left—The lens becomes more spherical to view nearby objects. Right—An unusually short eyeball causes farsightedness; a long eyeball causes nearsightedness.

However, in other animals, including man, images are focused on the retina in a different way. As we have seen, a lens is able to bend rays of light. The important point is this. The rays will be bent more or less depending on how much the surface of the lens is curved. The greater the curvature, the more the rays will be bent.

When we view a near-by object, the rays of light which are reflected from it and into the eye must be bent more than those from a distant object. Otherwise, the image will not be brought into sharp focus. Thus, an eye may accommodate for near vision merely by increasing the curvature of the lens. This increased curvature will result if the lens is allowed to round up and assume a more spherical shape. And, indeed, this is exactly how our eyes accommodate for near vision.

Normally, the suspensory membrane exerts a slight outward pull or tension on the border of the lens. This flattens the front and back surfaces a little, reducing their curvature and making the lens suitable for distant vision. This is the state of the lens when the eye is at rest. No muscular work is required to maintain it. For this reason, viewing objects at a distance is not tiring.

However, when we look at an object which is closer than about twenty feet, the lens rounds up and increases its curvature. The lens is able to round up because the suspensory membrane is relaxed. This releases the tension on the lens border. Since the lens is somewhat elastic, it tends to become spherical of its own accord. Now, relaxation of the suspending membrane is brought about in a most remarkable way. Recall

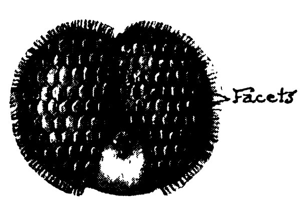
that the outer edge of this circular membrane is attached to the ciliary muscle. When the ciliary muscle contracts, the membrane re laxes. This may seem queer, since the contraction of a muscle usually tenses anything attached to it. But, actually, the fibers of the ciliary muscle run at right angles to those of the suspensory membrane. Therefore, when the ciliary fibers shorten during contraction, tension on the membrane is released.

This explains why looking at near objects is tiring. It should be clear that when the ciliary muscle tires, focusing light-rays from the printed page, for instance, becomes more and more difficult. We all know that after a long period of reading the eyes can best be rested by looking far off into the distance.

Some people have eyeballs which are unusually short from front to back. In such cases, the image of a near object can not be focused on the retina. The lens just can not round up and bend light-rays enough. The level of focus always lies behind the retina. These people are said to be farsighted, because their lenses work well for distant objects. But if they are to read or do close work, they must wear glasses which will assist the lenses in bending light-rays.

In other individuals, the eyeball is too long from front to back. Here, even the small curvature of a lens at rest tends to bring distant objects to a focus in front of the retina. There is nothing that the eye can do about this, for once the ciliary muscle is relaxed, the pull which flattens the lens is at a maximum. The only kind of accommodation possible would round the lens and bend the light-rays even farther away from the retina. By holding an object close to his eyes, such a nearsighted individual can move the focus level backward onto the retina. But he is helpless when it comes to seeing something in the distance unless he wears correcting glasses.

We have now mentioned every main structure within the eyeball except the materials which lie between the cornea and the lens and between the lens and the retina. These spaces are filled with clear, viscous fluids which prevent distortion of the focused light-rays. A viscous fluid is thick, like honey. Between the cornea and the front of the lens the fluid is only slightly viscous; it is almost watery, in fact. It is therefore known as the watery, or aqueous, humor. Behind the lens, extending back to the retina, the fluid is thicker and nearly glassy in appearance. Thus, it is called the vitreous humor, from the Latin word for glass.



Top—An insect's eye; each facet is itself a tiny eye. Bottom—A bird's eye, much like our own.

We have traced the path of light-rays through the eye and have seen something of how their number and direction are controlled. Now it is time to examine the structure on which the image finally falls. This, as we have learned, is the retina.

Like the brain of which it is really a part, the retina is a very complex organ. It is composed of many layers and has a number of different types of cells. The retina is easiest to understand, however, if we consider it as a cup-shaped organ which is very thin and contains three layers of cells.

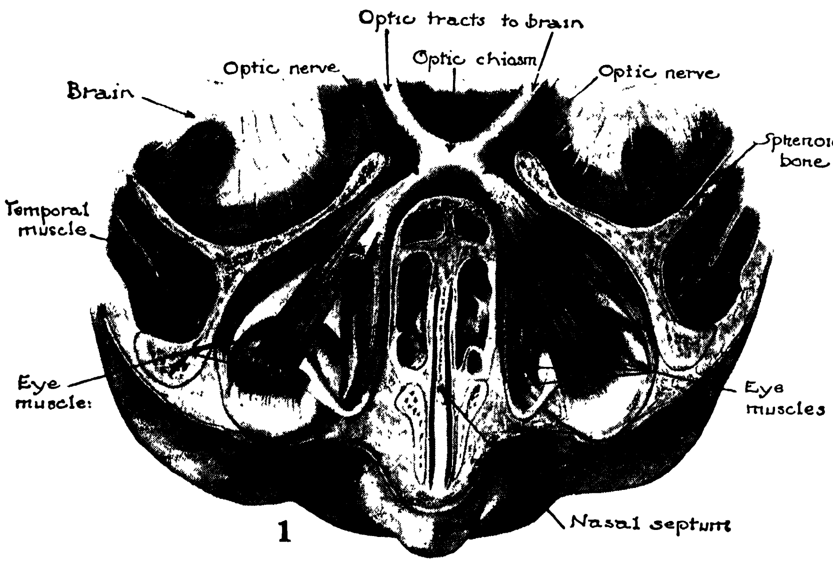
The first and perhaps the most interesting of these cellular layers is the layer of the rods and cones. The rods and cones are the cells which are actually stimulated by the arriving light-rays. Therefore, they are the true light-sensitive, or visual, cells. They are named from their resemblance to tiny rods and cones, although, to be sure, this resemblance is very superficial in man.

In one human retina there are more than 100,000,000 rods and some 6,000,000 cones. Thus, each cell is extremely small. These visual cells are lined up side by side in a single layer at the very back of the retina. That is, they are nearer the surrounding pigmented layer and farther from the vitreous humor than either of the other retinal layers. Each rod and each cone has a short fiber extending from it and touching one of the cells of the layer immediately in front.

This second, or middle-cell, layer is the bipolar layer. It is given this name because each cell in the layer has two fibers, one stretching out from either end of the cell body. Thus, every cell of this layer has two poles from which its fibers arise, and so it is called bipolar.

When light stimulates the visual cells, it starts impulses in them. Those impulses then pass forward to stimulate the

A LOOK INTO THE MACHINERY OF THE EYE



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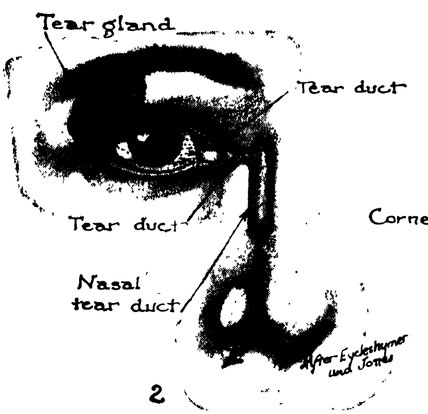

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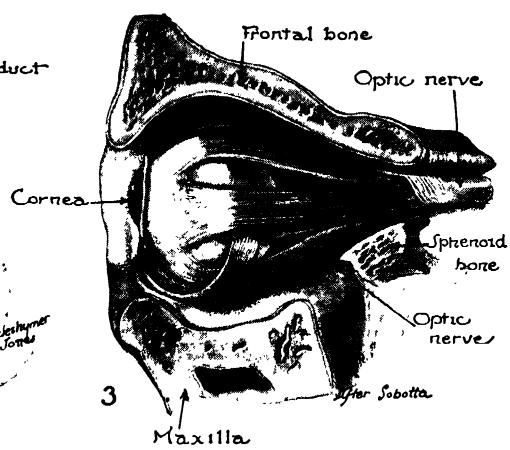

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Number 1—If you could look down into the top of your own head, you would see something like this. After the optic nerve leaves the back of the eyeball, it travels a little less than two inches to an intersection called the optic chiasma. Here the nerves from each eye meet and crisscross before continuing on. When they reach the brain, the nerves deliver the message that they received from the eyes. The optic nerve has the largest diameter of any nerve in the head. Shown, too, are the muscles of the eye. By operating these muscles you can move your eyes up and down, right and left or even around in circles. Number 2—The right eye, showing the gland where tears are made, and the duct through which they are carried to the nose after washing the eyeball. In crying, the tears come so fast that they can not all get through the ducts; therefore, they overflow. Number 3—A side view of the eye. Look at the muscles which control its motion. Each eye has six of these muscles, plus another one whose duty it is to elevate the eyelid.

bipolar cells. Generally, each cone touches and excites only one bipolar cell. But many rods usually end together on a single bipolar cell, and excite it. For this reason, cone vision is usually sharper and clearer than the images which result when the rods are stimulated. We shall see shortly why this fact is important.

All the bipolar cells in turn pass along their impulses to the cells of the transmitting layer. It is so called since it transmits the light messages on through the optic nerve to higher brain centers. The transmitting cells lie at the very front of the retina, close to the vitreous humor. From each cell, a long, delicate nerve fiber arises and courses over the front of the retina toward the optic nerve. There it joins with its fellows to form that nerve.

At the point where the transmitting fibers come together to form the optic nerve, the retina is bare of all visual cells. This region, hardly a sixteenth of an inch across, is unable to react to light and is therefore a blind spot. In other words, any image which falls only on this part of the retina will be invisible. Ordinarily, we do not notice this partial blindness, because the eyes move constantly and only a small and always changing part of any image falls on the blind spot. However, there are many ways of demonstrating that it exists.

THE ANSWERS TO SOME OF THE QUESTIONS ABOUT DAY AND NIGHT VISION

Now we are ready to understand some of the things which are concerned with actual vision. During the daytime, all the things around us are seen sharply and in color. At night, everything is clothed in various shades of gray, and is seen only dimly. Why is our day vision extremely clear and sensitive to colors? And why should our night vision be very sensitive to dim light but insensitive to color?

The answers to these questions lie in the special properties of the rods and cones. We have already learned one of these properties. We have seen that a large number of rod impulses usually come together on a single bipolar cell. In the case of cone impulses, however, each bipolar cell receives its stimulation from only one or, at the most, a very few cones.

Very dim light will start weak impulses in many rods. Now each one of these weak impulses alone may be too slight to excite a bipolar cell. But, since many of them come together on a single bipolar cell, their effects add up. The total effect thus becomes big enough to cause stimulation. Each individual impulse which now goes on to the brain is the sum total of several impulses gathered from a relatively large area of the retina. The final result is a dim visual image. It will not be seen very sharply.

A STRONG IMPULSE RECEIVED BY A CONE IS SENT TO THE BRAIN VERY DIRECTLY

Just the opposite holds true for the cones. A weak cone impulse will not be added to those from many other cones, simply because so few of them touch any one bipolar cell. But now notice: if the light is bright enough to start a strong cone impulse, the message is passed more directly to the brain from a very much smaller part of the retina. The image which results from several such impulses will, therefore, be much sharper.

There is even more to the story than this. Rods contain a special chemical substance which makes them very sensitive to even the dimmest light. The cones are not so well off; they require a fairly bright light to stimulate them.

Animals which are active mostly at night, rarely showing themselves in the daytime, have their retinas made up almost completely of rods. In contrast, "sun-worshiping" animals, which seek seclusion and safety during the night, have mostly cones. It is only in forms that use their eyes twenty-four hours a day that both cell types are present in abundance. These and other facts offer ample proof that rods are concerned with night vision, cones with day vision.

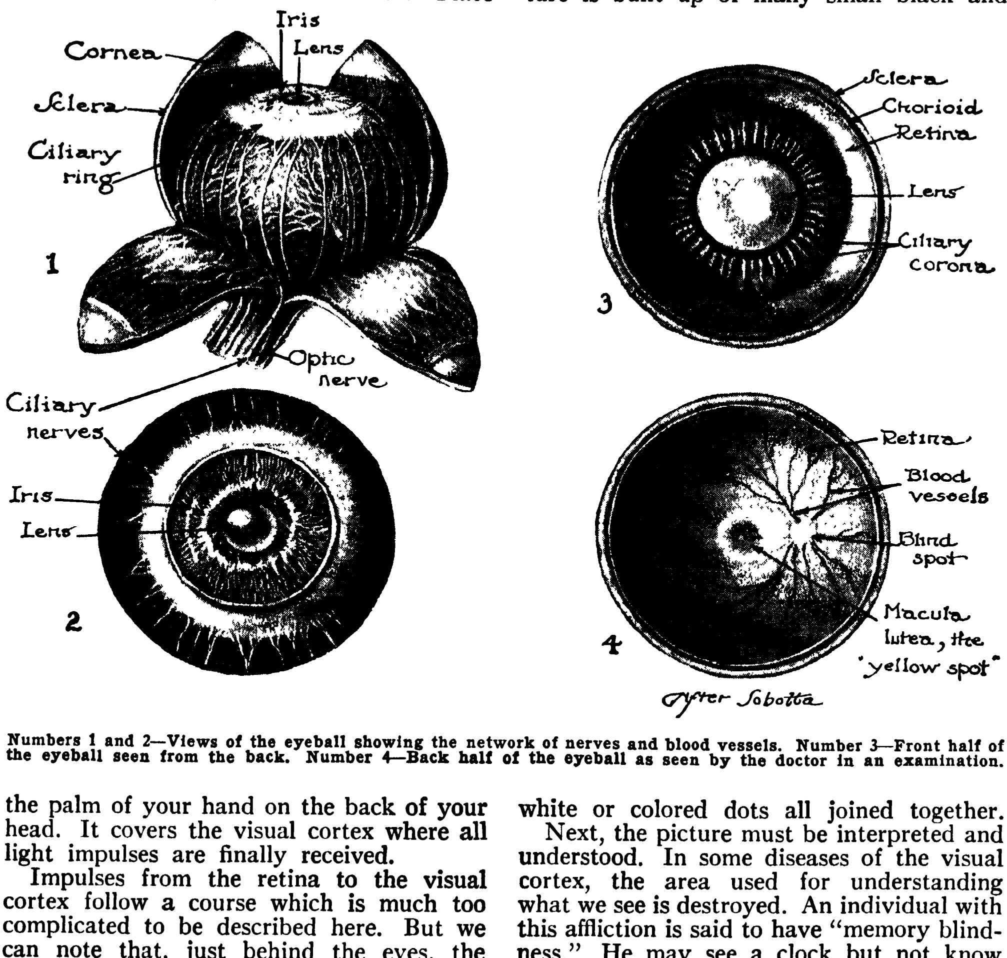
The retina of man is thus a double organ. It has one set of cells, cones, to be used in bright light for sensing sharp, colored images. These cones are more numerous in the center of the retina. In one place, they are highly concentrated and this area, the so-called yellow spot, gives the sharpest images of all.

A second cell group, rods, is used mainly during periods of relative darkness. These rods are very sensitive to dim light, but do not allow one to see very clearly or to see color. Rods lie more toward the sides of the cup-like retina. This explains why we see things better at night by looking out of the corners of our eyes.

Light impulses arising in the retinas of our eyes are carried over chains of cells to the optic nerve and along this nerve to the brain. We become conscious of the sensation of vision only after the impulses reach the brain. In other words, we really see

with our brains. Our eyes do not see, even though they are essential for seeing. They only serve to pick up a special type of stimulus, that is, light, change it considerably and then send it along to the brain. Only then does conscious vision take place.

Like all areas of the brain which control conscious sensations, the visual areas lie in that thin, gray mantle over the surface of the cerebrum—the cerebral cortex. Place the palm of your hand on the back of your head. It covers the visual cortex where all light impulses are finally received.



Numbers 1 and 2—Views of the eyeball showing the network of nerves and blood vessels. Number 3—Front half of the eyeball seen from the back. Number 4—Back half of the eyeball as seen by the doctor in an examination.

Impulses from the retina to the visual cortex follow a course which is much too complicated to be described here. But we can note that, just behind the eyes, the right and left optic nerves undergo a partial crossing. Some fibers in each nerve cross over to the opposite side of the brain, the rest go straight on to their own side. The net result of this crossing is that each side of the brain, whether right or left, receives messages from both eyes. This seems to be important in helping us move both our eyes together rather than each one separately. The crossing probably has little to do with giving "depth" to our vision or in causing the images from the two eyes to "fuse," as many people have claimed.

Once the visual impulses have reached the visual cortex, we see. To make this possible, the messages must, of course, be joined together into a single picture. For comparison, one should think of the way a printed picture is built up of many small black and white or colored dots all joined together.

Next, the picture must be interpreted and understood. In some diseases of the visual cortex, the area used for understanding what we see is destroyed. An individual with this affliction is said to have "memory blindness." He may see a clock but not know what it is, or be able to tell the time until he touches it and feels the hands. He may see a friend but not recognize him until the friend speaks. Thus, the understanding of what one sees is just as important as the fact of seeing. Both things depend on the visual cortex.

By Mac V. Edds.

THE NEXT STORY OF OUR OWN LIFE IS ON PAGE 4441.

Keystone View Co.

Lovely white pigeons clamor without fear over their good friend, Jack Miner.

JACK MINER, A MAN WHO LOVED BIRDS

ABOUT two miles north of the little town of Kingsville, Ontario, on the north shore of Lake Erie, is the bird sanctuary of Jack Miner. From his boyhood years Jack loved the woods and the things of nature —the birds and animals, the trees and lakes and crisp air and fresh sunshine.

Miner's love for birds found vent in very practical ways; not only did he shelter and feed the thousands of hungry birds that visited his sanctuary year by year, but in his lectures and by his example he strove to influence people to protect rather than to wipe out our feathered friends.

In his endeavor to know the birds he made many experiments and had countless fascinating experiences. He warned us against the birds' natural enemies, or "cannibal birds," as he called them. (The worst are the hawks, and of these the medium-sized ones are the greatest offenders.) Then there are the weasels. These took his pheasant eggs and his young chickens and turkeys, so he set concealed traps and baited them with hens' feathers. The traps were so successful that he caught fifty-seven weasels the first summer and soon almost killed the pests off in his neighborhood.

Miner had pet robins around his place because he encouraged the brave and cheery little birds. As soon as the worms start coming to the surface in the spring someone must send the robins a telegram, for they come north no matter how cold it is. They stay until the worms go under the ground for the winter. To the average farmer Robin Redbreast is a benefactor, for he cleans up the cutworms that destroy the crops. It is true, though, that he sometimes takes a little fruit.

Miner loved the woodpeckers as forest-protectors, noting how they make gimlet holes in the worm-eaten wood and then with their long sharp bearded tongues draw out the grub. Six different varieties of swallows had at some time or other visited his part of Canada, and he was not content until he had every variety of them coming again regularly with the seasons. To lure the pretty purple martin, he set up a twenty-room bird mansion one evening, and early the next morning he saw from his window a pair already hovering about the house. Before long there was a colony of these shy birds.

On one occasion on the Miner farm a house cat robbed an old gray duck of her seven young; the poor old lady carried on

pitifully for two or three days and then disappeared. Miner went to visit a brood of ducks that a hen was sitting on and found that all had hatched and gone but two. Where were they? Suddenly he saw the eyes of old Mrs. Duck sitting motionless in the weeds just in front of the coop. From her wings stuck out a little head! She was stealing the hen's ducks as fast as they hatched. She stole them all and raised them all.

BY TAGGING THE BIRDS, MINER LEARNED THE STRETCH OF THEIR SEASONAL FLIGHTS

To prove that birds return to the same homes year after year, Miner started a system of putting a band of aluminum bearing his address on one of a bird's legs. If the birds so marked were killed, these tags were returned to him; and he was thus able to learn the stretch of their winter or summer flights. If the tagged birds came back, it added to his proof of the birds' choice of the same home each year. One spring he presented four little ducklings with leg-bands and the names of Polly, Delilah, Susan and Helen. The sisters flew away in December. Helen was shot the next day, but Polly, Delilah and Susan came back again on different days in March. They migrated again in the fall, and this time Susan fell to the sportsman's gun. Polly and Delilah returned, as before, in March. For four springs the wild ducks continued to come. Then one winter Polly did not migrate and was shot by a wild-goose hunter. Delilah came back for three more summers, each time raising a family.

Because of the tags many interesting letters came to the Miner home. The tags came back from the far, frozen north, often sent in by Hudson's Bay Company officers who received them from Eskimo hunters, and from the southernmost limit of the ducks' flight.

Miner became well acquainted with the Canada goose. His interest dated from quite early, when he went hunting them on an old lighting haunt of theirs not far from his home. He used decoys, imitation birds made of wood and painted. After these were placed he lay in a cavity under an earth-colored blanket and waited till the geese swooped down from the sky to light beside the decoys. The painted geese did not fool the real ones for long; suddenly they took alarm and wheeled high again.

Then Miner bought seven wing-clipped Canada geese and fed them in a mud hole on his farm. The geese became very tame and roamed around on some ten acres, making the mud hole their home. For four years these live decoys attracted no wild geese, but in the fifth spring the whole neighborhood was awake one morning early. "The geese have come! The geese have come!"

On one shooting expedition a big gander fell with a broken pinion (wing), and Jack took him up and performed a surgical operation on him. He had a brother with the flock, and when the others migrated north in May, this self-sacrificing gander gave up all his liberties to live in captivity with his lame brother. The Miners nicknamed them David and Jonathan, and Jonathan tried hard to get David to fly once more. The two lived together in the park for seven years, but one morning as Miner looked out of the window he saw dear old Jonathan lying dead on the snow. The story could be read from the tracks in the snow. A great horned owl had attacked the geese in the night, and all of the clipped-wing geese, including David, ran under the evergreens and shrubs. Jonathan, having both wings, gave the enemy battle, but in the darkness the owl sank his talons into the gander's head and killed him. Miner avenged his pet's death. He set a trap in its feathers which caught the owl that very night.

THE NESTING GROUNDS OF THE CANADA GOOSE ARE LOCATED AFTER SEVEN YEARS' EFFORT

In order to get information about the nesting grounds of the Canada goose, Miner tagged his visitors. That is an easy thing for me to write about and for you to read of, but it took him over seven years to perform the trick. He built a large wire-net inclosure between his two ponds, with a trap door at each end. He educated his domestic geese to winter under this; and in the spring, when the wild birds came, they also went in under to feed. Miner waited until the greater part of the flock had gone north so as not to frighten them; then he pulled the trap door on sixty-one and tagged these, then let them go. Each year more were tagged and from the answers received to many of his tags, from Indians and Hudson's Bay employees, Miner was able to locate the nesting grounds of his pets, far north, in the frozen Hudson and James bays.

Of the two varieties of native swans, the trumpeter and the whistling, the former, which is the largest migratory bird in America, made its nest in cultivated parts of the country and has been almost exterminated. The whistling swans came to Miner's place,

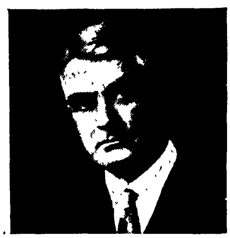
after the geese had adopted it, in such large numbers that the surface of Lake Erie near his home was at times white with them over a large area. Some wounded ones that had floated over Niagara Falls were sent to him, and from their number he tried to raise a flock.

A bird sanctuary such as Miner's is a suitable area of ground set aside for the birds to congregate in for shelter, food and protection, where their natural enemies are destroyed. The migratory birds will come to such a sanctuary in great numbers as they get to know it, and the non-migratory birds will winter in it.

When Jack Miner died in 1944, the word was sent over most of the busy telegraph and cable systems of the world. He was a modest, unassuming man, living on a quiet farm far from the great world centers. He died at a time when the daily news was earth-shaking in its importance; yet millions who had heard of his work for the birds took time to give respectful thought to his memory.

THE MAYO CLINIC

THIS is the story of three people who worked together for many years bringing thousands of ill people back to health. These three were the famous Mayo brothers and Sister Mary Joseph, a nun of the Order of St. Francis.

These brothers, both doctors, Charles Horace and William James Mayo, were valiant fighters against disease. They continued the great work begun by their father, who was also a doctor.

The Mayo brothers, Dr. William and Dr. Charles, were sons of William Worrall Mayo, who came to America from England in 1845. He studied medicine and became a physician in 1854. In 1863 he made Rochester, Minnesota, his home.

His first son, William James, was born in 1861. The second boy, Charles Horace, was born four years later. From the time they were quite young they helped their father, driving the horse on his sick calls, later aiding in operations and learning to assist with anesthesias. He taught them the structure of the body, using as object lesson the skeleton of a Sioux Indian warrior named Cut Nose, who had been executed for his part in instigating the terrible Sioux uprising in Mankato, Minnesota, in 1862. The boys learned to use a microscope in their father's office. They learned about drugs by working in the town drugstore during their school vacations. By the time both brothers had finished their medical courses at college, they were ready and eager to enter their father's office and share his growing practice.

Dr. William joined his father in 1883. That same year a cyclone struck the town of Rochester, killing and injuring many people. Dr. William Worrall Mayo was given charge of a temporary hospital in which the wounded were cared for. Volunteer nurses flocked to his assistance, among them a group of nursing sisters from the near-by Convent of St. Francis.

The help of these good women was intelligent and efficient. The doctor was grateful for their unselfish services. They admired his skill and recognized in him a great physician and surgeon. The mother superior of the convent proposed that her religious order supply funds for a permanent hospital in the town, to be directed by Dr. Mayo and his two sons, with Sisters of St. Francis as nurses. The offer was quickly accepted, and St. Mary's Hospital was opened, with thirteen patients, in 1889.

In those days hospitals were not so popular. Now it is realized by most ill people that intelligent care can be given best in a hospital, but fifty years ago many entered a hospital with reluctance, even with fear.

Nevertheless the group of three doctors and five plucky nursing sisters had no fear of failure. For one thing, they were all willing to work. The nurses divided their hours of duty like a ship's watches, and followed the schedule with unfailing regularity. The hospital succeeded because patients went into it, sick and fearful, and came out well. The doctors believed in surgery and seemed to have a genius for it. Some of their surgical success was due to use of aseptic and antiseptic methods, new at the time.

You have read in THE BOOK OF KNOWLEDGE that the work of Pasteur and of Lister

was not everywhere accepted. St. Mary's used, from the day its doors were opened, the findings of Pasteur and Lister. Word soon went out that few patients died after operations by the Mayo brothers. In 1904 there were 3,151 operations performed at St. Mary's. In 1925 the number was 23,628. By this time, however, Dr. William Worrall Mayo had retired, and a number of assistant surgeons, trained in the Mayo methods, had joined the staff. St. Mary's added a new wing in 1905, but before long new hospitals were being built in Rochester, four in all, and hotels for patients and close relatives of those who came to the town in search of health. In 1922, a new and much larger St. Mary's hospital was completed.

THE STAFF OF SURGEONS AND PHYSICIANS GREW

In the early days, the three Mayos diagnosed ailments, did all the surgery and directed medical care for all patients. Gradually, however, it was necessary to add to the staff, and to increase their offices in the town. In 1914 they opened their own office building, or clinic, with consulting rooms for each member of the staff, comfortable waiting rooms for the patients, laboratories, rooms for special examinations and space for modern medical and surgical equipment. By this time the members of the staff were highly trained specialists. Some diagnosed, others gave X-ray treatments, others administered anesthetics. There were medical experts and surgeons. Many of the surgeons today specialize on the eyes or ears, nose and throat or on other parts of the body. However, the standard set for all Mayo Clinic physicians and surgeons has been one of wide general medical knowledge. If the patient is too ill to come to the clinic, tests are given in the hospital to which he or she is assigned.

THE OPPORTUNITIES FOR LEARNING ATTRACTED MEDICAL STUDENTS

Young physicians and graduates of medical schools began, years ago, to apply for places in the clinic and in the various hospitals which it served. The experience to be gathered here, and the knowledge and skill to be gained by working under the direction of the Mayos, attracted serious and ambitious students. The Mayos felt a sense of duty toward these young men and women, and gave them as complete training as possible. They realized that while the chief work of the clinic was to make patients well, not to train young doctors, nevertheless here was an opportunity for wider service in the cause of health. If more doctors and surgeons could have the benefit of training in the Mayo Clinic, they could carry Mayo methods to other cities and other hospitals, and thus help many more sufferers.

THE ESTABLISHMENT OF THE MAYO FOUNDATION

Although many thousands of poor people had been treated at the clinic without charge, or upon payment of small fees, the fees from well-to-do patients amounted to a considerable sum each year. The Mayo brothers had, early in their career, begun to lay aside the major portion of their income in a special fund. By 1914 the fund had reached the amount of $1,500,000. The Mayos turned this over to the University of Minnesota, to be administered as the Mayo Foundation, in the form of a graduate school, to advance medical training and medical research in the university. The foundation established headquarters in Rochester, and the many facilities for study and research afforded by the clinic were freely opened to the students. From then on, the young men and women who have come to Rochester from medical school to learn more about the business of being a doctor have been sure of well-planned and well-conducted study and experience.

The clinic building of 1914 soon became too small, for more and more patients kept coming to Rochester, more doctors were needed, and new and bigger laboratories, a larger medical library and conference rooms. In 1929 the present Mayo Clinic, an imposing skyscraper, was opened.

THE GOOD WORK WILL GO ON

Before their death, these two famous brothers arranged for the continuance of the Mayo Foundation. In the words of Dr. William J. Mayo "The people's money, of which we have been moral custodians, is being returned to the people."

In March, 1939, Sister Mary Joseph died. She had joined the nursing staff of St. Mary's a few months after the hospital opened, in 1889. For a quarter of a century she had been surgery assistant to Dr. Will, who had often called her the foremost of his helpers. Two months after her death, Dr. Charles Mayo died, and in another two months, Dr. William J. Mayo died. But their work will continue through men and women they have inspired and taught.

THE NEXT STORY OF GOLDEN DEEDS IS ON PAGE 4577.

Courtesy, Mexican Government Railway System

A country scene below Mount Orizaba, Mexico's highest mountain.

MEXICO AND CENTRAL AMERICA

SOUTH of the United States, but still a part of the continent of North America, lie Mexico and Central America — seven states in all—besides a territory which is a part of the British Empire. Throughout these lands there runs that vast mountain chain, which, under different names, extends from Alaska in the Far North to the southern part of South America.

When this mighty chain enters Mexico from the north, it divides into two branches, the eastern Sierra Madre and the western Sierra Madre, both running parallel with the coast lines. Between these two ranges lies a large plateau, which extends from northern Mexico to the Isthmus of Tehuantepec, in the south of the country. This lofty plateau is broken by great *barrancas* or ravines, generally running from east to west; their steep sides are often heavily wooded.

In the lofty plateau region of Mexico the climate is usually delightfully cool. Along the coasts, however, extends the so-called hot zone where tropical growths flourish in abundance and the temperature reaches 100 degrees and more. Other districts, particularly on the slopes of the mountains, make up what is known as Mexico's temperate zone. As you see, therefore, Mexico has an almost infinite variety of climates. Infinite, too, are the varieties of agricultural and mineral wealth to be found in this favored land.

The history of the early peoples of Mexico has not yet been fully revealed. The Mayas, who lived in the south of the country, established a splendid civilization, which was at its height as early as the first century of the Christian Era. The Toltecs flourished in the vicinity of what is now Mexico City from about the eighth to the eleventh centuries. Their chief god was Quetzalcoatl, the "Fair God." A wise ruler, he is said to have gone away to the East to a land of plenty; he promised, however, that some day he would return to rule over his beloved country.

About the year 1000 the Toltecs were driven south by the Chichimecas (or Chichimecs). Next came various tribes of the Nahua stock. Among these tribes were the Aztecs, who finally won supremacy over the others. The Aztecs were still in power when the Spaniards burst in among them.

The civilization of the Aztecs was remarkable in many ways. Some of their palaces and temples were very large. They used a

system of picture-writing and had large schools. Their workmen did wonderful work in gold, silver and copper. The Aztec civilization had its dark side, however. The religion of the Aztecs was a thing of fear and horror. They had thousands of gods, chief among whom was the terrible Huitzilopochtli, the war god, to whom human sacrifices were made.

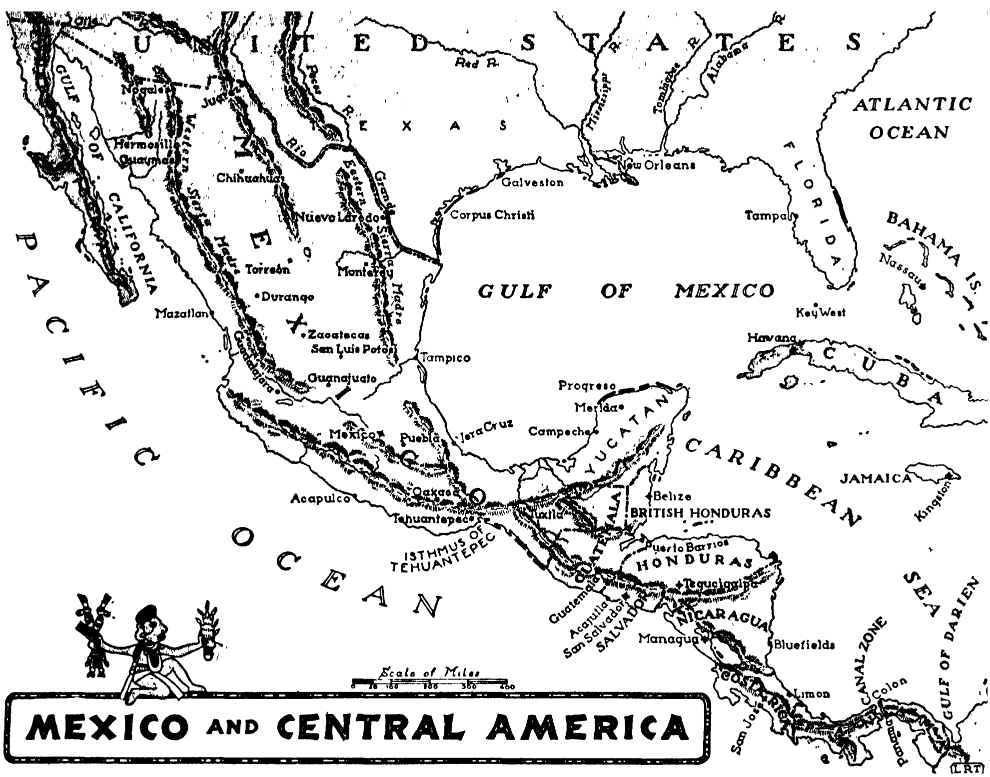
The Spaniards, as you know, established the first settlements in the New World in several of the islands that are now known as the West Indies. The Spaniards of Cuba, one of the most important of these early settlements, heard wonderful tales of the unbelievable wealth to be found in a mighty inland kingdom to the west.

At last the governor of Cuba decided to send an expedition to find out about this mysterious land. We have told you (page 393) how the leader of the expedition, bold Hernando Cortés, conquered the mighty kingdom of the Aztecs (1519-21).

For the next three hundred years (1521-1821) the conquered country was part of the Spanish province known as Nueva España, or New Spain. In time this province included all of the far-flung Spanish possessions in North America—Lower and Upper California and a goodly portion of what is now the southwestern part of the United States.

In 1535 New Spain became a viceroyalty—that is, a province governed by a viceroy, a governor appointed by the Spanish king. The viceroys had certain clearly defined duties. First and foremost, they were to enrich the treasury of Spain with the wealth drawn from the province. To aid in attaining this purpose, the colonists were not permitted to trade with other countries or even with other Spanish colonies. The viceroys were also required to hold in subjection the conquered population.

The task of subduing the Indians of New Spain and making them meek and devout



This map shows Mexico and the various states of Central America. The rugged mountains of this region form part of a great mountain chain extending from Alaska to the southern part of South America.

Courtesy, Mexican Government Railway System

Pyramid of the Sun, Toltec ruin at San Juan Teotihuacán, near Mexico City.

subjects of the Spanish king was carried out in various ways. By the system of *encomiendas,* a large number of the natives were commended (*encomendados,* in Spanish) to the tender mercies of their conquerors. To a certain Spaniard, say, was assigned a certain number of natives. He was to feed and clothe them and teach them the principles of Christianity. In return the Indians were to give their labor. In many cases the task of converting the natives was given to missionaries, to whom were assigned certain districts of the country.

In a generation or two after the conquest practically all of the Indians were converted and they settled down more or less resignedly to their lot of bondage under a foreign overlord. Some still lived in native villages and cultivated the communal village lands (that is, lands owned in common), called *ejidos.* Some labored in a condition of serfdom on the estates of great landowners or in the mines. These Indians were considered an inferior race; they were expected to serve and obey.

The ruling classes—the officials who governed the country and the owners of vast estates and rich mines—found life very pleasant in the province of New Spain. As time went on, many fair towns were built and fine cathedrals and schools arose on every hand. Roads and bridges made trade and travel easier.

Between the comparatively small class of the very wealthy and the enormous class of the hopelessly poor, there grew up in time a middle class that had neither the wealth of the first group nor the hopeless resignation of the second. An important element in this middle class were the Creoles, as the American-born children of Spanish parents were called. They were considered, curiously enough, quite inferior to the Spaniards who came to New Spain from the mother-country. They could occupy only the lower offices in the civil administration and in the Church. As for the Mexicans of mixed ancestry (the *Mestizos,* as they were called) they occupied a considerably worse position. Though they included men of great ability, they had even fewer opportunities to better their lot than the Creoles.

In spite of these discontented elements, attempts at revolt were few and far between until the beginning of the nineteenth century. By that time the democratic ideas of the American Revolution had begun to spread to the Spanish colonies of the New World. Yet the final independence of Mexico was brought about, not because she came to adopt republican ideas, but because of the confused political situation in Spain

When the Emperor Napoleon
made his brother Joseph King
1808, many Spaniards did n
new monarch, but swore all
nand VII, who had been
The officers of New Sp

know which king to follow. Some Mexicans now thought that the time had come to shake off the foreign yoke altogether. In 1810 Father Miguel Hidalgo, a parish priest, started a rebellion, but it was put down and Hidalgo lost his life. Another priest, Father José Maria Morelos, who was a pupil of Hidalgo, started another revolution several years later. He, too, was unsuccessful, but the desire for freedom persisted.

Although fighting continued, the revolutionists did not make much headway. In 1814 Ferdinand VII had been restored to his throne. The royal representatives in New Spain, no longer having a divided allegiance, were able to direct all their energies against the revolutionaries.

HOW INDEPENDENCE CAME TO MEXICO AT LAST

At last independence came; the manner of its coming was most unusual. Ferdinand VII was reactionary by nature, yet in 1820 a revolt in Spain had forced him to adopt a series of radical measures directed against the conservative classes. The conservative groups in New Spain had hitherto been bitterly opposed to the idea of independence. Now, however, they decided to cut off all their ties with a mother country that had become so radical. Their champion, General Agustín de Iturbide, and Vicente Guerrero, the chief of the rebels, agreed to insist upon independence. The mother-country sent over a new viceroy, Juan O'Donojú, to discuss matters with the now formidable forces demanding independence. Against the wishes of his royal master, O'Donojú bowed to the demands of Iturbide and his allies. In August, 1821, it was agreed that New Spain, now called Mexico, should become an independent kingdom, ruled by a European prince.

As there was difficulty in selecting a suitable monarch, the ambitious Iturbide had himself proclaimed emperor (July, 1822); he was called Agustín I. His dictatorial acts soon roused the country against him. He was forced to abdicate in February, 1823, and he went into exile in Italy. The government was put in the hands of a military triumvirate (committee of three) for a time. Iturbide, convinced that the Mexicans were longing for his return, came back to Mexico in July, 1824; he was at once seized and shot by his former subjects. At last, in October of that year, a new constitution was adopted, setting up the Republic of Mexico.

The new republic had a hard time. The people had never had the opportunity to learn how to govern themselves, and there was little peace or order. Ambitious men struggled to become the masters of the new state and there was almost constant fighting. The most powerful man in this period of confusion was Antonio López de Santa Anna. He gained fame by driving out a Spanish army which was trying to put Mexico back under Spanish rule. In 1833 he became president for the first time, just when the Texas question became all-important.

When Mexico began to fight for her independence, Texas was occupied chiefly by a native Indian population, though there were a few white traders, missionaries and hunters. Later three hundred families were sent from Mexico to colonize the territory and a large number of Americans also settled there on grants of land. More and more Americans began to come in; at last the Mexicans, in alarm, forbade further immigration from the United States.

In 1835 an insurrection broke out in Texas against Mexican rule which the Texans claimed was oppressive and which was undoubtedly very inefficient at this time. The Texans won their independence in 1836 and set up the Republic of Texas. The Mexicans, however, refused to accept this state of affairs and made several unsuccessful attempts to conquer the new republic. In 1845, the United States granted the request of Texas

Courtesy, Grace Line

A street in Taxco, a town not far from Mexico City. The plain whitewashed walls on the buildings in most of the older towns show Spanish influence.

Courtesy, Mexican Government Railway System

Plaza de la Constitución, the great square in the centre of Mexico City. In the background is the beautiful cathedral, begun in the latter half of the sixteenth century and finished almost two hundred years later. It occupies an area of some 70,000 square feet. Its site is a part of the ground enclosed by the walls of the ancient Aztec temple. Note the two bell towers, 204 feet in height, that rise from the sides of the façade.

to make it a state of the American Union.

This decision led to much bitterness between Mexico and the United States and at last, in April, 1846, open war broke out between the two countries over a strip of land which both Mexico and the state of Texas claimed to own. This conflict, which was known as the Mexican War, did not last long. The American troops were well armed and disciplined and fought steadily. The Mexicans were brave but they were badly led. During the two years of the war twelve different men tried to rule in Mexico. Of course such frequent changes in the government did not help the Mexican cause. The Americans were victorious in every battle. When the Mexican capital was occupied (September, 1847), the struggle was practically at an end. In February, 1848, a treaty of peace was signed. Mexico gave up her claim to the disputed territory. She also gave up what is now California, Utah and Nevada and parts of New Mexico, Arizona, Colorado and Wyoming. The United States paid Mexico $15,000,000 for these territories.

For a time there was a period of comparative peace in the unfortunate country, and reform measures, seeking to curb the conservative elements, were passed. Then troubles began again. From 1858 to 1861 there was fierce fighting between the liberal forces, led by President Benito Juárez (he was a full-blooded Zapotec Indian) and the conservatives, under a bewildering succession of military leaders. At last Juárez was triumphant. He proceeded to put into full effect the reform measures that had already been passed.

The state of the country was so bad that Mexico had to postpone paying her foreign debts. Three of the creditor nations, Spain, England and France, sent armed forces to Mexico to protect their rights. England and Spain soon withdrew their troops, after they realized that Mexico meant to honor her debts as soon as possible. Napoleon III of France, however, hoping to win for France a position of great influence in the New World, did not withdraw his forces. He managed to establish a European prince, the Archduke Maximilian of Austria, as Emperor of Mexico, with the promise of support from France (April, 1864).

Maximilian now set up a gay court in a beautiful palace on the famous hill of Chapultepec, near Mexico City. Juárez withdrew to the north of Mexico and bided his time. His patience had its reward. The United States had been occupied with the Civil War while Napoleon had been carrying out his ambitious schemes. As soon as that bloody conflict was ended, however, the United States hastened to remind France that the countries of Europe had no right to

Courtesy, Grace Line

A native woman of Guadalajara, Mexico, at her simple, home-made spinning wheel.

interfere with the nations of the American continent. Napoleon, fearing to risk a war with the United States, decided to withdraw his troops.

Maximilian's young and charming wife, the Empress Carlotta, rushed to Europe to plead with Napoleon and the Pope in order to win for Maximilian the military support which he needed if he were to retain his throne. Carlotta could accomplish nothing. The strain and sorrow drove her out of her mind and she never recovered, though she lived to be very old. Maximilian, though he knew his cause was hopeless, refused to give up the throne or to leave the country. He was taken prisoner and shot (June, 1867).

In July, 1867, Juárez and his ministers entered Mexico City and set up the republic anew. Juárez remained at the helm of the state until his death in July, 1872. This great statesman is still revered by the majority of Mexicans.

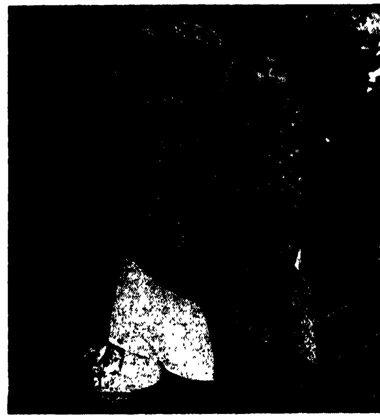
The next great name in Mexican history is that of Porfirio Diaz, who began as a revolutionary and who finally became the strong man (in other words, dictator) whom we meet so often in Latin-American politics. Diaz first served as president from 1876 to 1880. In 1884 he was re-elected and he remained at the head of the government for twenty-seven years.

He was very popular at the beginning of his rule. For one thing, he gave peace and security to a war-weary nation. Revolutions were put down with an iron hand; banditry was suppressed. The wealth of the country increased greatly, too, under his rule. Industry was encouraged, many new buildings were constructed and the harbors were improved. Many foreigners (particularly Americans and Englishmen) went to Mexico to help exploit the natural resources of the country. These great resources were now tapped as never before.

Yet Diaz made many serious mistakes, which at last brought about his downfall. For one thing, he was determined to keep

Courtesy, Interoceanic Railway of Mexico, Ltd.

In painting, architecture and design Mexico has a distinctive national art which shows a happy blending of Spanish and Indian traits. These decorated lacquerware pieces are from the state of Uruapan.



Many of the Mexican native costumes are surpassingly lovely, as for instance those of these Tehuantepec Indian girls. The headdresses are of frilled lace. Contrast the simple dress of the water-carriers on the right.

the supreme power in his own hands; he did not train other men to take over the government when he grew too old.

Nor did he do enough to help the poor people of Mexico. Most of them could neither read nor write and had no property except the clothes they wore. They worked terribly hard on the land or in the mines and yet they were nearly all in debt. Some of them, indeed, were worse off than they had been under Spanish rule. In New Spain, as we have seen, many of the Indians tilled the communal lands belonging to the villages. These Indians were often miserably poor, but at least they were their own masters. Diaz broke up the communal lands. In the majority of cases they passed into the hands of wealthy individuals or corporations; the Indians who had tilled these lands became the serfs of the new owners.

Another serious mistake of Diaz was that, in encouraging foreign capital, he had put many of the industries of the country, as well as much of its natural resources, in the hands of foreigners. Mexicans of every class came to resent bitterly this intrusion of outsiders, even though it had been encouraged at the outset by Diaz, the head of their own government.

By 1910 the opposition to Diaz had become formidable and a revolution broke out. In 1911 the Diaz government was overthrown and the weary old dictator went into exile in Paris. He was succeeded by a wealthy Creole, Francisco Madero, an amiable but weak man. In 1913 Madero was assassinated through the connivance of the treacherous commander of the army, General Victoriano Huerta. The latter proceeded to seize the government himself. Huerta was not able to win recognition from the United States, and he was quite unable to crush a widespread revolt organized by General Venustiano Carranza. At last, despairing of ever establishing a strong government, Huerta resigned in July, 1914, and left the country.

Open fighting now broke out between Carranza and a former supporter of his, the picturesque ex-highwayman, Francisco Villa.

Courtesy, Mexican Government Railway System

Part of the graceful dance, the Jarabe Japatío, sometimes called the Mexican Hat Dance.

At last Villa was crushed and Carranza took up the reins of government; his position was greatly strengthened when he was recognized by the United States (October, 1915). Villa entered upon a career of banditry and murder. He even raided an American town in March, 1916. The American Government sent an expedition to Mexico under General Pershing in pursuit of Villa; the latter managed to escape.

Carranza now determined to press for reform. A new constitution was drawn up and adopted in 1917. This document turned over all Church property to the nation; it granted labor the right to organize and strike; it provided for the state ownership and control of lands and natural resources. Carranza attempted to carry out the program outlined in the constitution. He was impeded, however, by growing disorder within the country. At last a revolutionary movement, under General Alvaro Obregón, swept all before it. President Carranza, fleeing from Mexico, was assassinated by a Mexican bandit chief. Obregón, who always insisted that he had no part in the assassination, became the next president.

In the administration of Obregón (1920-24) and in that of his friend, General Plutarco Calles (1924-28), the reforms outlined in the Constitution of 1917 were carried out to a certain extent, though not thoroughly enough to satisfy the extreme liberals. The reform program, however, received powerful backing in 1934, when General Lázaro Cárdenas, a full-blooded Indian, was elected to the presidency. Cárdenas, who had been elected for a six-year term, decided to adopt a Six-Year Plan, which was to carry out fully the provisions of the Constitution of 1917. Under Cárdenas the process of dividing up the large estates among the peasants was hastened. Farm co-operatives were established. Many important industries, like the railroads, the utilities and the oil industries, were taken over by the government. The rights of workers were safeguarded as never before.

In spite of all that had been done for the people, the end of Cárdenas' administration (1940) found Mexico in a serious plight. Agricultural production was lagging. The farm co-operatives had often become the playthings of politics. The workers, exalted by their recent gains, often made impossible demands and industry was rapidly becoming demoralized. Devout Catholics were angered at the extreme measures taken against the

Courtesy, Fruit Dispatch Company

Millions of bunches of bananas are grown in Mexico and Central America each year. The banana industry gives employment to large numbers of workers on the plantations, the railroads and the shipping lines.

Church. World War II had seriously threatened Mexico's foreign markets.

General Manuel Avila Camacho, the successor to Cárdenas, did much to improve conditions. While maintaining the rightful gains of labor, he fought unreasonable demands on the part of labor. He relaxed the measures taken against the Church. He sought to improve the relations between Mexico and the United States. In July, 1946, Miguel Alemán, supported by the government, was elected president. There is every indication that Mexico is now on the road that leads to good government.

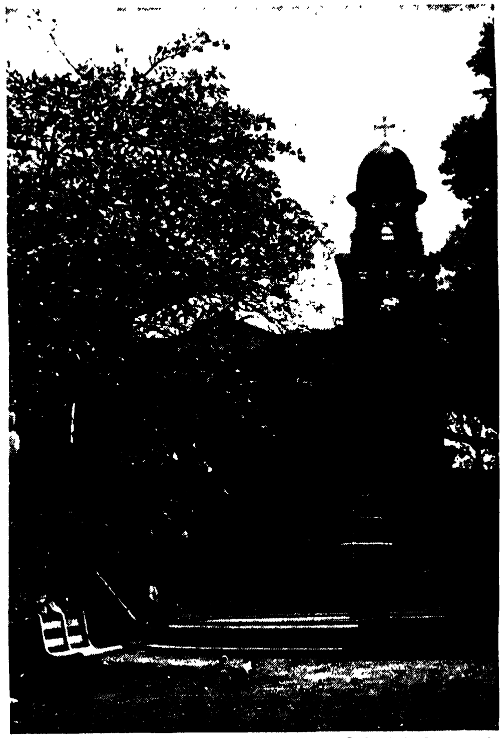
In size, in population, in natural resources, Mexico ranks high among Latin-American nations. She is the third largest Latin-American country, with an area of 763,944 square miles; she is the second most populous, with an estimated population of 19,500,000. In natural resources she has few equals among the nations of the Western Hemisphere. Yet the country has not made the most of her opportunities.

For one thing, some of her most valuable resources have hardly been tapped. For example, there are millions of acres of virgin soil in the tropical regions along the coast, in the mountain valleys and in the central plateau—soil which no plow has ever turned. Many more millions of acres have been only scratched, so to speak, as a result of the primitive agricultural methods that are still in wide use. In the present century some progress has been made in introducing modern farming methods; but much remains to be done to develop Mexico's riches.

Yet, for all her backward methods, Mexico raises great quantities of corn, rice, sugar, wheat, cotton, coffee, beans, tomatoes, tobacco, cocoa, bananas and sisal (sisal is a hemp-like fibre). It is estimated that about a half of the world's supply of sisal comes from Yucatan, in southeastern Mexico. Mexico's vast timber lands contain such valuable trees as pine, spruce, cedar, mahogany, logwood and rosewood.

The mines of Mexico are famous the world over for their apparently inexhaustible riches. The silver mines are the most productive in the world; in normal times, they produce some forty per cent of the world's supply of silver. Other mines produce gold, copper, lead, zinc, antimony, mercury, coal, molybdenum and arsenic, in large quantities. Yet many of these mines are not producing at full capacity, and many deposits of priceless ore are still untapped.

Mexico has enormous deposits of oil, which



© Ralph Hancock

The cathedral in Managua, capital of Nicaragua. This country is the largest, but most thinly populated, of the six Central American states.

have been tapped only within the present century. Mexico is now one of the world's leading producers of oil, with an output of approximately 43,200,000 barrels in a recent year. Though considerable oil has already been produced, experts claim that there are vast deposits not even discovered as yet along the coasts, and offshore, under the bed of the Gulf of Mexico.

When Mexico is able to utilize her resources fully and to maintain a stable government so that her wealth is not wasted in civil war, she will have a place among the great and prosperous nations of the world.

By far the largest city in the country is the capital, Mexico City, with a population of about 1,500,000. Mexico City was the largest city in the Western Hemisphere at the beginning of the nineteenth century; it is still a splendid city, of which Mexicans are very proud. It is the political, commercial and educational centre of the republic. Situated on the southern part of the central plateau, it is 7,434 feet above sea level.

The second city of Mexico, Guadalajara,

in the west, is an important mining center. It is also noted for its beautiful pottery. Monterrey, some 170 miles distant from the Texas boundary, is an important center for trade with the United States. Puebla, about 60 miles east of Mexico City, is a thriving manufacturing town. Some 25 miles away are the famous volcanoes of Popocatepetl and Ixtacihuatl. Mérida, in Yucatan, is also a manufacturing town; it is a center of the sisal industry.

San Luis Potosí, about 220 miles northwest of Mexico City, is the center of an important smelting industry. There are extensive ore deposits near the city. To the southeast lies Leon, famed for its manufactures of leather goods—saddles, harness, bridles, leather clothing embroidered in gold and silver. Vera Cruz, on the eastern coast, has a splendid harbor and has been an important element in the industrial growth of Mexico. Tampico, farther up the coast, also boasts of a fine harbor. It has prospered greatly since the discovery of oil in its vicinity.

THE COUNTRIES THAT MAKE UP CENTRAL AMERICA

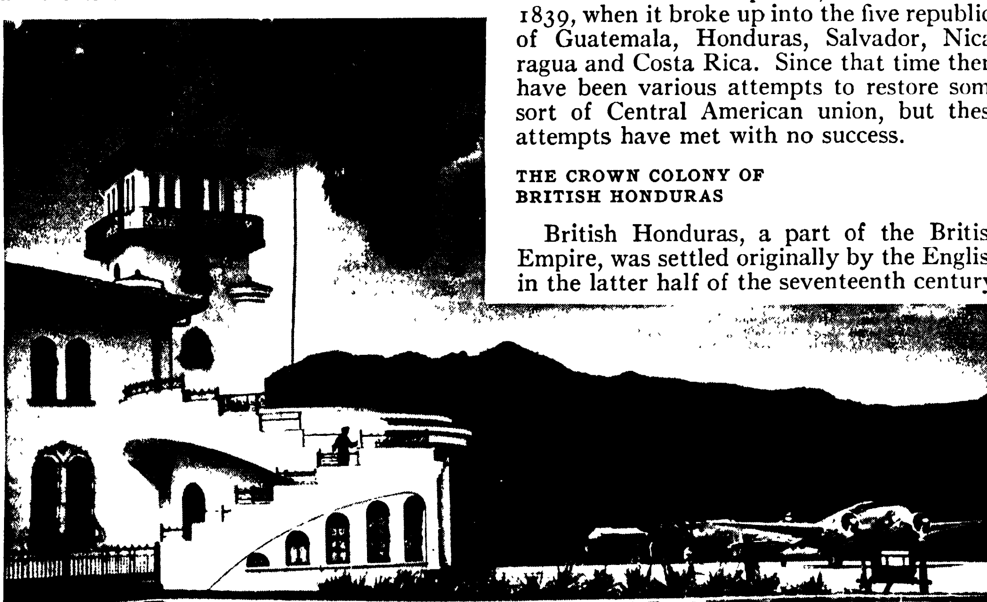
South of Mexico are six little states and a British colony, together known as Central America. The climate of Central America is almost as varied as that of Mexico. It is hot in the lowlands near the coast, cool higher up in the hills and really cold in the mountain regions. A good deal of rain falls, sometimes as much as 200 inches in a single year. Much of the soil is extremely fertile and one finds many varieties of crops. There are dense forests with many kinds of valuable trees. In the rugged mountains there are vast deposits of ore.

The first settlement in Central America was made in 1502 by Columbus in what is now the country of Costa Rica. Other settlements followed and by 1525 most of the Central American territory had been brought under Spanish rule. It was organized as a separate province, called Guatemala, and was put under the rule of a military official, known as a captain general. (The present Central American republic of Panama, however, formed part of the Spanish South American viceroyalty of New Granada and was later a part of Colombia.) Guatemala was under the jurisdiction of New Spain in the raising of armed forces and in tax collection. Otherwise its administration was entirely independent of that of the northern viceroyalty.

In 1821 Guatemala declared its independence of Spain. For a time it was united to independent Mexico under Agustín I (Iturbide). When he fell, the Central Americans formed a federated republic; this lasted until 1839, when it broke up into the five republics of Guatemala, Honduras, Salvador, Nicaragua and Costa Rica. Since that time there have been various attempts to restore some sort of Central American union, but these attempts have met with no success.

THE CROWN COLONY OF BRITISH HONDURAS

British Honduras, a part of the British Empire, was settled originally by the English in the latter half of the seventeenth century.



© Ralph Hancock

The airport's beautiful terminal building at San José, the capital and chief city of Costa Rica.

Courtesy, United Fruit Company

Donkeys and oxcarts are still seen in the mountains of Guatemala, where many roads are rough wagon tracks.

The wealth of the forests soon attracted many settlers, and this colony, known at that time as Belize, became a flourishing one. The Spaniards made several attempts to drive out the English from Belize in the eighteenth century, the last attempt being made in 1798. At last the Spaniards desisted. From that time to this, Belize, now known as the crown colony of British Honduras, has had a comparatively tranquil existence, ruffled occasionally by boundary disputes with Guatemala.

Like Guatemala, British Honduras is bounded on the north by Mexico. Its western and southern boundaries are formed by Guatemala; its eastern boundary, by the Caribbean Sea. The colony has an area of 8,598 square miles and a population of about 58,000. Belize (population, 17,000) is the capital. The chief products of British Honduras are mahogany, logwood, cedar, tropical fruits and chicle.

THE REPUBLIC OF GUATEMALA

Guatemala, the northernmost of the Central American states, has an area of 45,452 square miles and an estimated population of 3,000,000. Its capital, Guatemala City (population 165,000), is by far the largest of the country and is the centre of industry and commerce. Agriculture is Guatemala's most important industry. The principal crop is coffee, which in normal times accounts for 70 per cent of the country's total exports. Other crops include bananas, sugar, beans, wheat and corn. Guatemala exports large quantities of chicle gum, for chewing gum manufacture, to the United States. Guatemala has extensive forests and promising mineral deposits but not much has been done to develop these resources.

THE REPUBLIC OF HONDURAS

East of Guatemala lies Honduras, which, with an area of 44,275 square miles, is about the size of Pennsylvania. The population of Honduras is about 963,000. Tegucigalpa (population, 35,000) is the capital of the country. Honduras has a flourishing banana industry; coconuts are also an important crop. Mineral resources—gold, silver, copper, lead, zinc, iron and antimony—are abundant; there is considerable production of gold and silver, but production of the other minerals is slight.

THE REPUBLIC OF SALVADOR

The tiny republic of Salvador, the smallest of the Central American countries (area, 13,176 square miles), is bounded on the south by the Pacific Ocean; Honduras is to the east and north and Guatemala to the west. Its population is about 1,500,000. The capital, San Salvador, has a population of 102,000. Salvador is a one-crop country; the crop in question, coffee, furnishes about 90 per cent of the exports. Like its neighbors, Salvador has dense forests and great mineral

deposits—including gold, silver, coal, copper, iron, lead and zinc—which are but slightly developed.

THE REPUBLIC OF NICARAGUA

Nicaragua is the largest of the Central American republics, with an area of 60,000 square miles. It is thinly populated; its population, estimated at 1,200,000, is smaller than that of little Salvador. The capital, Managua (population, 115,000), was almost totally destroyed by an earthquake in 1931 but has been largely rebuilt. The principal agricultural products of Nicaragua are bananas, coffee and sugar-cane. The great forests contain mahogany, cedar and other valuable trees. Wild rubber grows in abundance, but there are few rubber plantations because of the labor shortage. Some gold is mined; copper and precious stones are also found. Lake Nicaragua, in the southwest of the country, is the largest inland sea in Central America. It has been proposed to construct a canal that will connect the waters of the lake with the Caribbean and the Pacific.

THE REPUBLIC OF COSTA RICA

Costa Rica, to the south, has an area of 23,000 square miles and an estimated population of 600,000. The capital city, San José (population, 71,000) is situated inland. The country's chief seaport, Puerto Limón, is on the Caribbean; it occupies the site where Columbus landed on his last voyage to the New World. Costa Rica's chief crop is coffee; bananas, cocoa, corn, sugar-cane, rice and potatoes are also cultivated. There are large forests, which might be a source of wealth, but the lumbering industry is, so far, only slightly developed. Gold and silver are mined in considerable quantities; there are also deposits of quartz, alabaster, granite, oil, alum, slate, onyx, mercury, sulphur and copper.

THE REPUBLIC OF PANAMA

There were only five Central American republics until 1903, when Panama became the sixth. This strip of land had been a part of the Republic of Colombia since 1821. In 1903, however, the Panamanians revolted and established a republic of their own. It was charged at the time that this revolt was fostered by the American Government, because Colombia had held up negotiations for the construction of a canal across the Isthmus of Panama. At any rate, the newly

Courtesy, United States Lines

Ruins of old Panama, six miles from the present city. The pirate Sir Henry Morgan looted and burned old Panama in 1671.

formed republic of Panama very speedily granted the United States the right to construct the canal, about which we tell you on page 360.

The republic of Panama has a very extensive coastline, 477 miles long on the Atlantic, 766 miles long on the Pacific. The area of the republic is 32,380 square miles; the population is estimated at 650,000 (these figures do not include the Canal Zone, through which runs the Panama Canal). The capital, Panama (population, 128,000) is near the Pacific end of the Panama Canal but not in the Canal Zone. The important port of Colón, near the Atlantic end of the Canal, is within the Zone. However, like the city of Panama, Colón is under the authority of the Panama Government, though the United States has the right to see that both cities are kept clean.

More than half of the republic of Panama is unoccupied and only a small part is cultivated. The most important crop is bananas; other products include cocoa, coffee, coconuts and ivory nuts. The country has rich timber resources, largely undeveloped. Stock raising is extensively carried on.

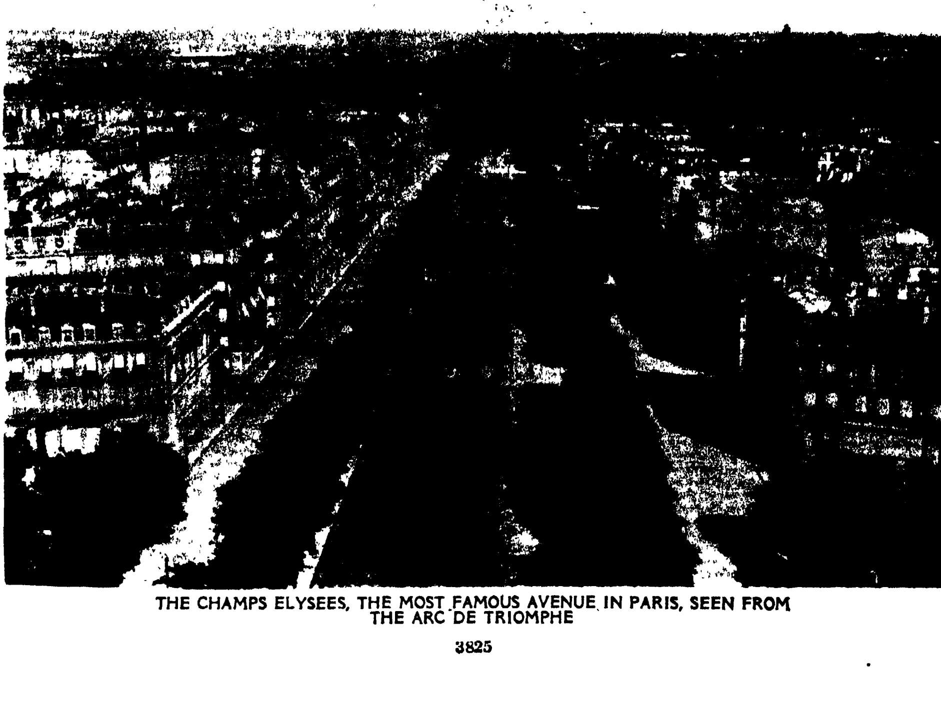
The Canal Zone, over which the United States now has permanent control, is a strip of land ten miles wide, extending across the country from the Atlantic to the Pacific. It has an area of 553 square miles and a population of about 52,000.

The Canal Zone is strongly fortified. It is occupied by a garrison as well as by civilian employees of the Canal.

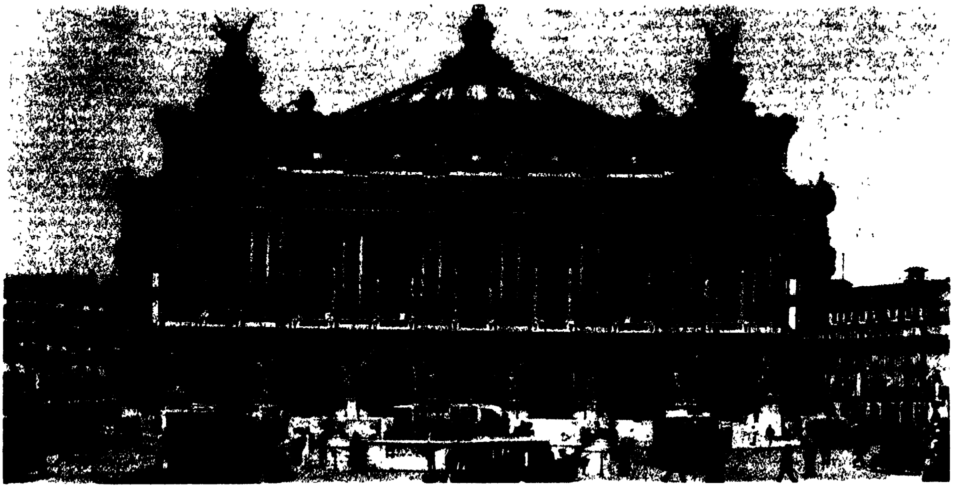
THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 4155.

PICTURES OF BEAUTIFUL PARIS

SEVEN BRIDGES OF PARIS



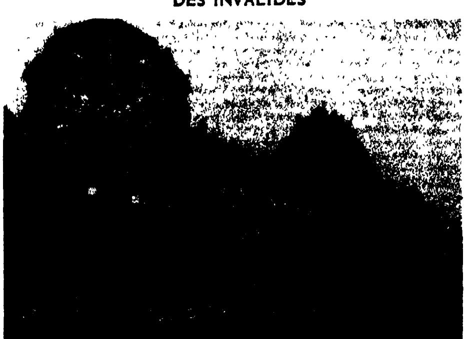
THE CHAMPS ELYSEES, THE MOST FAMOUS AVENUE IN PARIS, SEEN FROM THE ARC DE TRIOMPHE



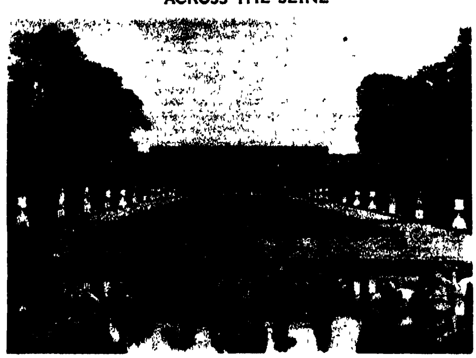
THE MOST MAGNIFICENT PLEASURE HOUSE IN EUROPE—THE PARIS OPERA

NAPOLEON'S TOMB—THE DOME DES INVALIDES

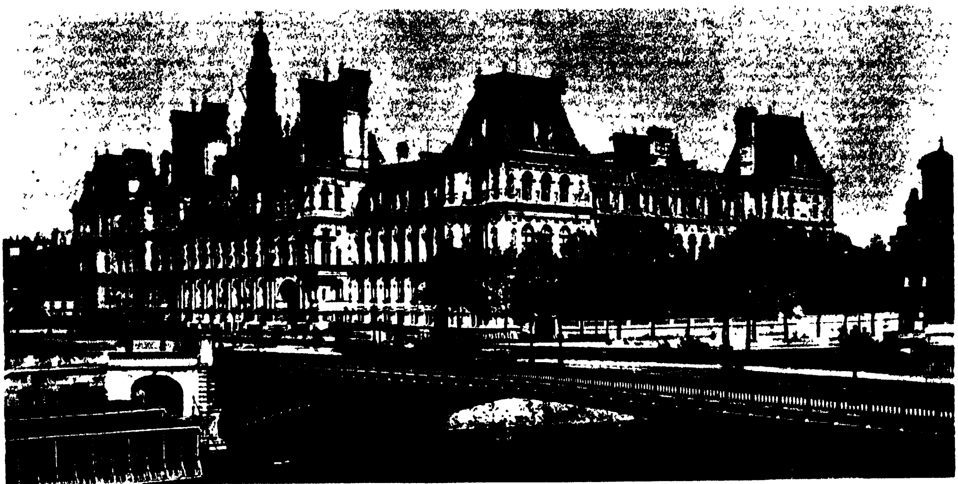
THE ALEXANDER III BRIDGE ACROSS THE SEINE



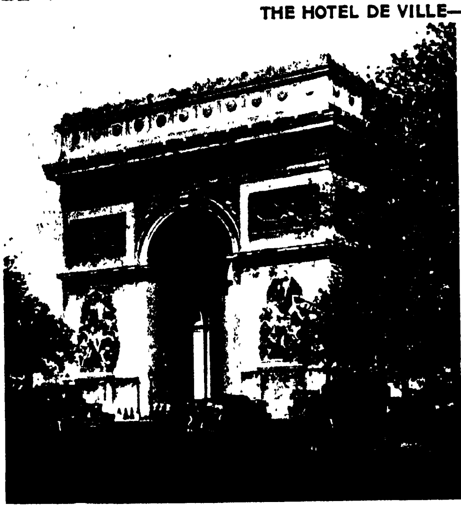
THE LOUVRE



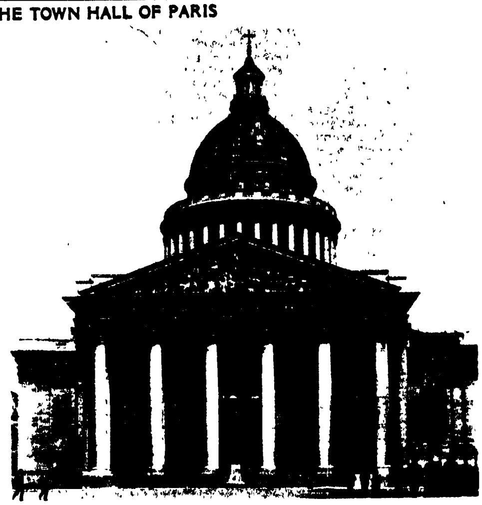
IN THE GARDENS OF VERSAILLES



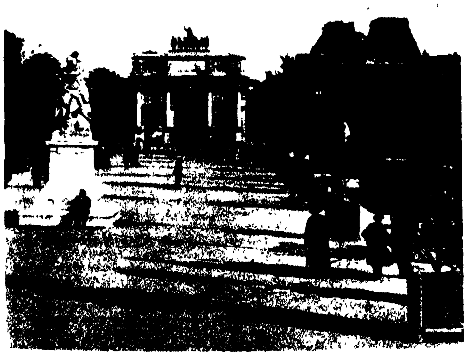
THE HOTEL DE VILLE—THE TOWN HALL OF PARIS



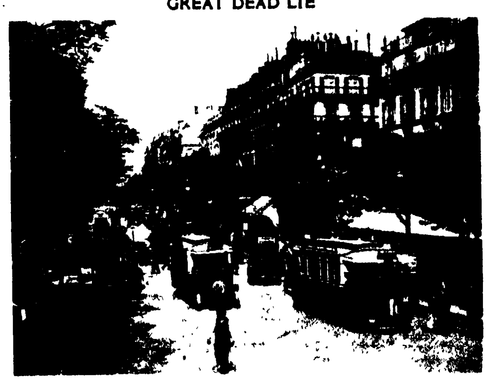
THE GREAT ARC DE TRIOMPHE, UNDER WHICH THE UNKNOWN WARRIOR LIES



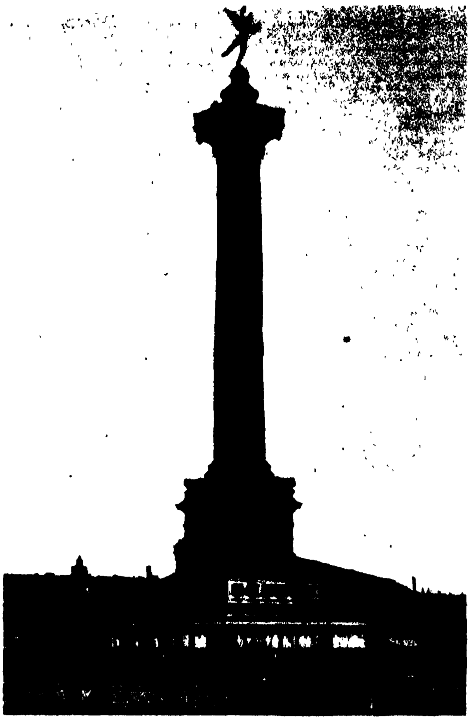
THE PANTHEON, IN WHICH THE GREAT DEAD LIE



THE LITTLE ARC DE TRIOMPHE NEAR THE LOUVRE



THE BOULEVARD MONTMARTRE, A CHARACTERISTIC STREET OF PARIS



THE GREAT COLUMN ON THE SITE OF THE BASTILLE

THE VENDOME COLUMN IN THE HEART OF PARIS

THE MADELEINE, PARIS, IS BUILT IN THE STYLE OF A ROMAN TEMPLE; IT IS NOT MODELED ON THE GREEK PARTHENON

Rapunzel's Golden Ladder

A YOUNG Prince was hunting one day in a forest in Germany when he heard a girl singing sweetly and sadly to herself. He followed the sound and came to a tower in which there was no door or stairs. As he stood among the trees, wondering where the entrance was, a Witch hobbled up and sang:

"Rapunzel! Rapunzel!
Let down your hair."

A lovely maiden at once came to the window at the top of the tower, and unbound her golden tresses, and they were so long that they touched the ground, and the Witch slowly climbed up them.

"Ah," said the Prince, "I will use that golden ladder!"

When the Witch departed, he also sang:

"Rapunzel! Rapunzel!
Let down your hair."

Rapunzel did so, and he ascended. But, oh, how startled she was when he appeared! She had never seen a man before. The Witch had taken her from her parents when she was a baby and put her in the tower, and there she had grown up all alone. The Prince talked to her so lovingly that her heart was soon won, and she promised to marry him.

"Now, my dearest," said the Prince, when it grew dark, "I must find a silken ladder by which you may escape. I will bring it tomorrow when the Witch has gone away."

Unhappily, Rapunzel was very simple-minded. When the Witch came and climbed up her hair, she said: "How long you take, granny! The Prince climbs up in an instant."

"What!" said the Witch, raging with anger. "After all the trouble I have taken to keep you separate from the world, you let down your hair for a man to climb up! You must die!"

Seizing a pair of scissors, she cut off Rapunzel's hair, led her into a desert and left her there to perish. The Witch then returned to the tower, and climbed up by means of the golden tresses, which she had tied round the window-bar.

"Rapunzel! Rapunzel!
Let down your hair,"

From his hiding-place in the shrubbery the prince saw the Witch climb up Rapunzel's golden hair.

sang the Prince, as he came through the forest, carrying a silken ladder. Then, seeing the tresses, he gaily climbed up, and entered the room.

"Ah, ah!" shrieked the Witch, as she saw him looking around for Rapunzel. "The pretty little bird isn't in the nest. The cat has killed it, and the cat is going to scratch your eyes out."

She pushed the Prince, and he tumbled out of the window, and fell on a bush, and the thorns pierced his eyes. After wandering blindly about the forest, he came to the desert, and heard Rapunzel singing sweetly and softly to herself.

He followed the sound, and she saw him, and ran up and fell upon his neck weeping, and two of her tears fell in his eyes, and he recovered his sight.

The bad old Witch, who had been watching from the top of the tower, saw the lovers meet, and she was so angry at their happiness that her rage choked her and she died.

The Prince at once led Rapunzel to his father's kingdom, and there they were joyfully married in great splendor and lived happily ever after.

And among their prized treasures was a rug made from Rapunzel's hair, which the Prince recovered from the tower.

The Husband Who Was to Mind the House

By KAY NEILSEN

ONCE on a time there was a man, so surly and cross, he never thought his wife did anything right in the house. So, one evening, in hay-making time, he came home, scolding and swearing, and showing his teeth and making a dust.

"Dear love, don't be so angry; there's a good man," said his goody; "tomorrow let's change our work. I'll go out with the mowers and mow, and you shall mind the house at home."

Yes! the husband thought that would do very well. He was quite willing, he said.

So, early next morning, his goody took a scythe over her neck, and went out into the hayfield with the mowers, and began to mow; but the man was to mind the house, and do the work at home.

First of all, he wanted to churn the butter; but when he had churned a while he got thirsty, and went down to the cellar to tap a barrel of ale. So, just when he had knocked in the bung, and was putting the tap into the cask, he heard overhead the pig come into the kitchen. Then off he ran up the cellar steps, with the tap in his hands, as fast as he could, to look after the pig, lest it should upset the churn; but when he got up, and saw the pig had already knocked the churn over, and stood there, routing and grunting in the cream which was running all over the floor, he got so wild with rage that he quite forgot the ale-barrel, and ran at the pig as hard as he could. He caught it, too, just as it ran out of doors, and gave it such a kick, that piggy lay for dead on the spot. Then all at once he remembered he had the tap in his hand; but when he got down to the cellar, every drop of ale had run out of the cask.

Then he went into the dairy and found enough cream left to fill the churn again, and so he began to churn, for butter they must have at dinner. When he had churned a bit, he remembered that their milking cow was still shut up in the byre, and hadn't had a bit to eat or a drop to drink all the morning, though the sun was high. Then all at once he thought 'twas too far to take her down to the meadow, so he'd just get her up on the house-top—for the house, you must know, was thatched with sods, and a fine crop of grass was growing there. Now the house lay close up against a steep down, and he thought if he laid a plank across to the thatch at the back he'd easily get the cow up.

But still he couldn't leave the churn, for there was his little babe crawling about on the floor, and "if I leave it," he thought, "the child is safe to upset it." So he took the churn on his back, and went out with it; but then he thought he'd better first water the cow before he turned her out on the thatch; so he took up a bucket to draw water out of the well, but, as he stooped down at the well's brink, all the cream ran out of the churn over his shoulders, and so down into the well.

Now it was near dinner-time, and he hadn't even got the butter yet; so he thought he'd best boil the porridge, and filled the pot with water and hung it over the fire. When he had

When he reached the top of the cellar stairs and saw that the pig had already knocked over the churn full of cream, he was wild with rage.

So he began to grind away; but while he was hard at it, down fell the cow off the house-top after all, and as she fell, she dragged the man up the chimney by the rope. There he stuck fast; and as for the cow, she hung half-way down the wall, swinging between heaven and earth for she could neither get down nor up.

And now the goody had waited seven lengths and seven breadths for her husband to come and call them home to dinner; but never a call they had. At last she thought that she'd

done that, he thought the cow might perhaps fall off the thatch and break her legs or her neck. So he got up on the house to tie her up. One end of the rope he made fast to the cow's neck and the other he slipped down the chimney and tied round his own thigh; and he had to make haste, for the water now began to boil in the pot, and he had still to grind the oatmeal.

waited long enough, and went home. But when she got there and saw the cow hanging in such an ugly place, she ran up and cut the rope in two with her scythe. But, as she did this, down came her husband out of the chimney; and so, when his old dame came inside the kitchen, there she found him standing on his head in the porridge pot. After that he never complained of his wife's housekeeping.

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The Princess Who Became a Goose Girl

From GRIMM'S FAIRY TALES

A BEAUTIFUL Princess was to be married to a Prince whom she had never seen. All preparations were made for the wedding, and the time came when the Princess had to bid farewell to her mother. The Queen was very sad at this parting, for the Prince's kingdom was so far away that she might never see her daughter again.

As they were saying good-bye the Queen remembered a charm and pricked her finger so that three drops of blood fell on her handkerchief. Giving it to her daughter, she said: "Carry this with you wherever you go, and no harm can ever befall you. Lose it: you are in danger."

The Princess thought this strange, but she obeyed, and soon set out with her maid to the land where the Prince lived. They were both riding, and before they had gone far, the Princess began to feel very thirsty.

"Please fetch me some water from the brook," she said to the maid.

But the maid answered rudely: "I shall not. Get it yourself."

The Princess made no reply, but alighted from her horse, drew the water, and rode on again.

And the handkerchief said: "If your

The unhappy Princess wept, and the handkerchief fell from her hand into the brook and floated away.

mother only knew, her heart would surely break in two."

By-and-by the Princess said: "I am thirsty again. Please fetch some water."

But the maid answered: "You may fetch it yourself. I am not your maid any longer."

Again the Princess made no reply, but alighted from her horse and drew the water.

And the handkerchief said: "If your mother only knew, her heart would surely break in two."

The Princess wept, and the handkerchief fell from her hand into the brook.

Then the maid, who knew that the handkerchief could no longer protect her mistress, said: "Give me your dress, and take mine. We will change places. Take my horse, and I shall take your horse Falada. I shall marry the Prince, and everyone must think that I am the Princess. If you refuse, I shall kill you."

The Princess was so terrified that, to save her life, she consented, and they rode on. Presently they came to the palace, and the maid was treated as the Princess, and the Princess as the maid.

As the poor Princess stood, sad and alone, in the courtyard, the King looked out of the window and saw her.

"Do you want work?" he asked kindly, feeling for her loneliness.

"Yes, please," answered the Princess.

"I want a girl to help my lad Kurdchen to tend the geese," said the kindly King, "and if you would like to stay here, you may be my little goose girl."

And so the Princess became a goose girl, and spent her days with Kurdchen, tending the geese.

Now, the wicked maid was afraid that the horse Falada might tell the King all that happened, so she ordered his head to be cut off. But the Princess loved Falada, and she persuaded Kurdchen to hang its head over the kitchen door, and every day as she went out she would say to it: "Do you know who I am, Falada?"

And the head would answer her: "You are the Princess. If your mother only knew, her heart would surely break in two."

One day the Princess let down her golden hair while Kurdchen was by. The lad was so struck with its beauty that he wanted to cut off a lock for himself. But the Princess refused, and this made him so angry that he ran to the King and told him that she was a witch.

When the King heard the story of the talking head that hung over the door and the goose girl's beautiful golden hair, he wondered what it all meant. The next day he sent for her, to discover.

The Princess entered the palace and appeared before the King, who was so impressed with her beauty and grace that he said: "You are no goose girl. Tell me who you are."

"Alas! I dare not say," she replied. "I have sworn to tell no one, and if I break my word I shall be killed."

Then the King said: "I am the King of all this land. No one shall hurt you. Tell me all, and I will protect you."

The Princess burst into tears.

"I am the real Princess who was to marry your son, the Prince," she said; "but my maid took away my dress and my horse because she wished to marry him herself and she threatened to kill me if I told anyone. If my mother only knew, her heart would surely break in two."

"Do not be afraid," said the King, who had long suspected the maid and knew at once that this was really the Princess who ought to marry his son.

The King comforted her, had her dressed in royal robes, and sent for the Prince. She looked so beautiful and happy that the Prince immediately fell in love with her, and they were married that very day. A great feast was prepared, to which all the people of the Court were invited, and there was much rejoicing and merry-making because the true Princess had married the Prince. The wicked maid was severely punished, as she well deserved, and banished from the country, and the Prince and Princess lived happily ever after.

The King said: "I am the King of all this land. No one shall hurt you. Tell me all, and I will protect you."

The Story of Fairyfoot

Once upon a time there stood far away in the West Country a town called Stumpinghame. Stumpinghame had a king of its own, and his name was Stiffstep; his family was very ancient and large-footed. Great feet had been the fashion there from time immemorial, and the higher the family the larger were they. His queen, Hammerheel, was the greatest beauty in Stumpinghame. Her Majesty's shoe was not much smaller than a fishing-boat; and their six children promised to be quite as handsome, and all went well with them till the birth of their seventh son, when it was whispered throughout the city that the queen's seventh child had been born with such miserably small feet that they resembled nothing ever seen or heard of in Stumpinghame, except the feet of the fairies.

The king and queen were so ashamed of him that the young prince was sent secretly out to the pasture lands, to be brought up by the shepherds. The chief man there was called Fleecefold, and people came from all quarters to see the young prince.

Out sprang a little man, dressed in russet brown.

The king and queen had given him fourteen names, beginning with Augustus; but the honest country people could not remember so many; besides, his feet were the most remarkable thing about the child, so with one accord they called him Fairyfoot.

He was a handsome boy, but the news of the court traveled to the shepherds, and Fairyfoot was despised among them. Fleecefold was ashamed to have him in his cottage, and as soon as he was old enough, Fairyfoot was sent every day to watch some sickly sheep that grazed on a wild, weedy pasture, near the forest.

Poor Fairyfoot, who was often lonely and sorrowful, was lying in the shadow of a mossy rock one warm summer noon, when a robin, pursued by a great hawk, flew into the old velvet cap which lay on the ground beside him. Fairyfoot covered it up, and the hawk, frightened by his shout, flew away.

"Now you may go, poor robin!" he said, opening his cap; but instead of the bird, out sprang a little man dressed in russet brown, looking as if he were a hundred years old. Fairyfoot could not speak for astonishment, but the little man said:

"Thank you for your shelter, and be sure I will do as much for you. Call on me if you ever want help; my name is Robin Goodfellow." And, darting off, he would have been out of sight in an instant had not Fairyfoot jumped up and called him back.

"What is it?" said the little man.

"I am very lonely, and no one will play with me, because my feet are not large enough," said Fairyfoot sadly.

"Come, then, and play with us," said the little man. "We lead the merriest lives in the world, and care for nobody's feet; but there are two things you must mind—first, do as you see the rest doing; and, secondly, never speak of anything you may hear or see."

"I will do that, and anything more you like," said Fairyfoot. Then the little man, taking his hand, led him over the pasture into the forest, and along a mossy path among old trees wreathed with ivy, till they heard the sound of music, and came upon a meadow where the moon shone as bright as day, and all the flowers of the year bloomed together in the thick grass. There was a crowd of little men and women, some clad in russet color, but far more in green, dancing round a little well as clear as crystal. And under great rose-trees, which grew here and there in the meadow, companies were sitting round low tables covered with cups of milk, dishes of honey, and carved wooden flagons filled with

As her feet touched the water they grew smaller.

clear red wine.

The little man led Fairyfoot to the nearest table and bade him drink. Immediately the red wine touched his lips, all his troubles seemed to leave him, and the little people about the well cried: "Welcome! welcome!" and everyone said: "Come and dance with me!" So Fairyfoot was as happy as a prince, and drank milk and ate honey till the moon was low in the sky; then the little man took him by the hand and led him back to his own bed of straw in the cottage corner.

Next morning Fairyfoot was not tired for all his dancing. Nobody in the cottage had missed him, and he went out with the sheep as usual; but every night all that summer, when the shepherds were safe in bed, the little man came and took him away to dance in the forest.

The wonder was that he was never tired or sleepy, as people are apt to be who dance all night; but before the summer was ended, Fairyfoot found out the reason. One night, when the moon was full, Robin Goodfellow came for him as usual, and away they went to the flowery green. The fun there was high, and Robin was in haste. So he only pointed to the carved cup from which Fairyfoot every night drank the clear red wine.

"I am not thirsty, and there is no use losing time," thought the boy, and he joined the dance; but never in all his life did Fairyfoot find it such hard work to keep pace with the company. Fairyfoot did his best, but at length he was glad to steal away and sit down behind a mossy oak, where his eyes closed for very weariness. When he awoke, the dance was nearly over, but two little ladies in green were talking near him.

"What a beautiful boy!" said one of them. "What handsome feet he has!"

"Yes," said the other, "they are just like the feet Princess Maybloom had before she washed them in the Growing Well, which has now dried up. Nothing in this world can make them small again, you know. Her father is heartbroken that her feet are no longer small and dainty, like those of all the other people in her country."

When they were gone, Fairyfoot could sleep no more for astonishment. It amazed him that Princess Maybloom's father was troubled at her feet growing large. All that day he was so weary that he got into sad disgrace with the shepherd for neglecting his sheep. The old man beat him so cruelly that he determined to run away.

So on and on he ran, far into the forest, until at last, utterly exhausted, he sank down at the foot of a tree and fell fast asleep. When he awoke, he heard voices.

"What boy is this?" said a nightingale on a branch above him. "He cannot have come from Stumpinghame with such small and handsome feet."

"No," said another; "he has come from the West Country. How in the world did he find the way?"

"How simple you are!" said a third nightingale. "What had he to do but follow the ground-ivy which grows over height and hollow, bank and bush, from the lowest gate of the king's kitchen-garden to the root of this rose-tree?"

Fairyfoot was greatly astonished at this conversation, and thought it might be as well for him to follow the ground-ivy. It was a long journey, but he found the gate at last, and walked through the garden, till a white fawn came frisking by, and he heard a voice calling sadly:

"Come back, come back, my fawn! I cannot run and play with you now, my feet have grown so heavy." And, looking around, he

They danced from sunset until the gray morning.

saw the loveliest young princess in the world, dressed in snow-white, and wearing a wreath of roses on her golden hair. At once he guessed that this must be the Princess Maybloom, and made her a very humble bow.

"Royal princess, I have heard of your trouble because your feet have grown large, and I know of a certain fountain in my country that will make them smaller and finer than ever they were," said he.

When the princess heard that, she danced for joy in spite of her large feet, and she and her six maids brought Fairyfoot before the king, who consented to allow the princess to accompany Fairyfoot to the marvelous fountain.

After traveling for some hours, they reached the place, and, sitting down, Princess Maybloom pulled off her stockings and dipped her feet into the fountain. The moment her feet touched the water they grew smaller, and when she had washed and dried them three times, they were as small and finely shaped as Fairyfoot's. There was great joy among the company, and the princess thanked Fairyfoot again and again.

Just at that moment, they heard a sound of music, and Fairyfoot knew it was the fairies going to their dancing-ground. Rising quickly, he took the Princess Maybloom by the hand, and all followed the music through the forest. At last they came to the flowery green. Robin Goodfellow welcomed the company for Fairyfoot's sake, and gave everyone a drink of the fairies' wine. So they danced there from sunset till the gray morning; but, before the lark sang, Robin Goodfellow took them all safe home.

There was great joy that day in the palace because Princess Maybloom's feet were made small again. The king gave Fairyfoot all manner of fine clothes and rich jewels; and when they heard his wonderful story, he and the queen asked him to live with them and be their son.

In the course of time Fairyfoot and Princess Maybloom were married, and they both lived happily ever after.

Lazy Jack

ONCE upon a time there was a boy whose name was Jack, and he lived with his poor old mother who got her living by spinning. Jack was so lazy that he would do nothing but bask in the sun in the hot weather and sit by the hearth in the winter. His mother was obliged at last to tell him that if he did not begin to work she would turn him out of the house.

This threat at length roused Jack, and he went and hired himself for the day to a neighboring farmer for a penny; but as he was coming home, he lost it in passing over a brook. "You stupid boy," said the mother, "you should have put it in your pocket."

"I'll do so another time," replied Jack.

The next day Jack went out again and hired himself to a cowkeeper, who gave him a jar of milk for his day's work. Jack took the jar and put it into the large pocket of his jacket, spilling it all long before he got home. "Simpleton!" said the old woman; "you should have carried it on your head."

"I'll do so another time," said Jack.

The following day Jack hired himself again to a farmer, who agreed to give him a cream

cheese for his services. In the evening Jack took the cheese and went home with it on his head. By the time he got home the cheese was completely spoiled, part of it being lost and part matted with his hair. "Dunce!" said his mother, "you should have carried it very carefully in your hands."

"I'll do so another time," replied Jack.

The day after this Jack again went out and hired himself to a baker, who gave him nothing for his work but a large tom cat. Jack took the cat and began carrying it very carefully in his hands, but pussy scratched him so much that he was compelled to let it go. When he got home, his mother said: "You numbskull, you should have tied it with a string and dragged it along."

"I'll do so another time," said Jack.

The next day Jack hired himself to a butcher, who rewarded him with a shoulder of mutton. Jack took the mutton, tied it to a string, and trailed it along after him in the dirt, so that by the time he had got home the meat was completely spoiled. "You ninneyhammer," cried his mother. "you should have carried it on your shoulders."

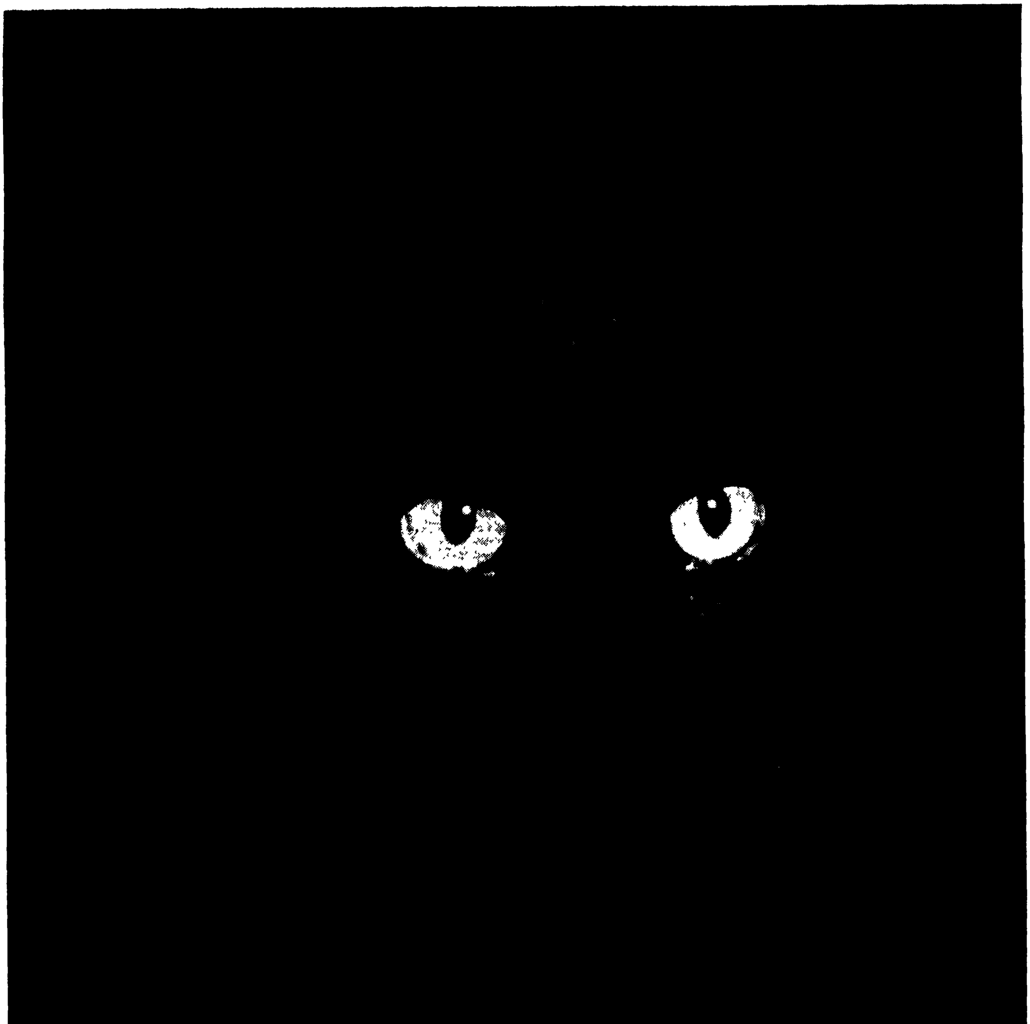
"I'll do so another time," said Jack.

Jack went once more and hired himself to a cattle-keeper, who gave him a donkey. Jack hoisted the donkey on his shoulders and began walking slowly home.

Now in the course of his journey there lived a rich man with his only daughter, a beautiful girl, but unfortunately deaf and dumb. She had never laughed in her life, and the doctors said she would never recover till somebody made her laugh. This young lady happened to be looking out of the window when Jack was passing with the donkey on his shoulders, legs sticking up in the air. The sight was so comical that she burst out laughing and recovered her speech and hearing. Her father was overjoyed, and married her to Jack, who thus became very rich.

THE NEXT STORIES ARE ON PAGE 3901.

The young lady saw Jack passing by with the donkey on his shoulders, its legs sticking up in the air.



Philip Gendreau

WHY CAN'T I SEE IN THE DARK?

YOU can't see in the dark because in order to see, the eye must receive light; and darkness is the absence of light. Most of the objects we see around us are visible by reflected light—reflected sunlight or reflected lamplight. Since darkness is the absence of light, there is no light in the darkness to be reflected from chairs, tables or people to our eyes, and therefore we can not see these objects.

Someone may have told you that cats and owls can see in the dark because they have special kinds of eyes. It is true that cats and owls can see better in partial darkness than we can, but not even they can see in total darkness. They can see more than we can when the light is dim because the pupils of their eyes can open wider and receive more light than our eyes can.

You have probably noticed that it is difficult to see much inside the house when you have just come in from the bright sunlight. After you have been in the house a little while, your eyes adapt themselves to

the dimmer light, and you can see perfectly well. It is true, too, that your eyes become somewhat accustomed to the dark after a while. If you go out of the lighted house on a dark night, you find that after ten or fifteen minutes you can see much better than when you first left the light.

WHY DO TWO SIDES OF A ROAD SEEM TO MEET IN THE DISTANCE?

You have probably noticed that the farther away an object is, the smaller it looks. If you stand close to a house, and hold your finger up against the wall, your finger measures only about two or three inches along the wall. And yet, if you stand a block away from your house, you can hold your finger up between your eye and the house, and your finger will *seem* longer than the house is high. The house seems smaller the farther you are from it.

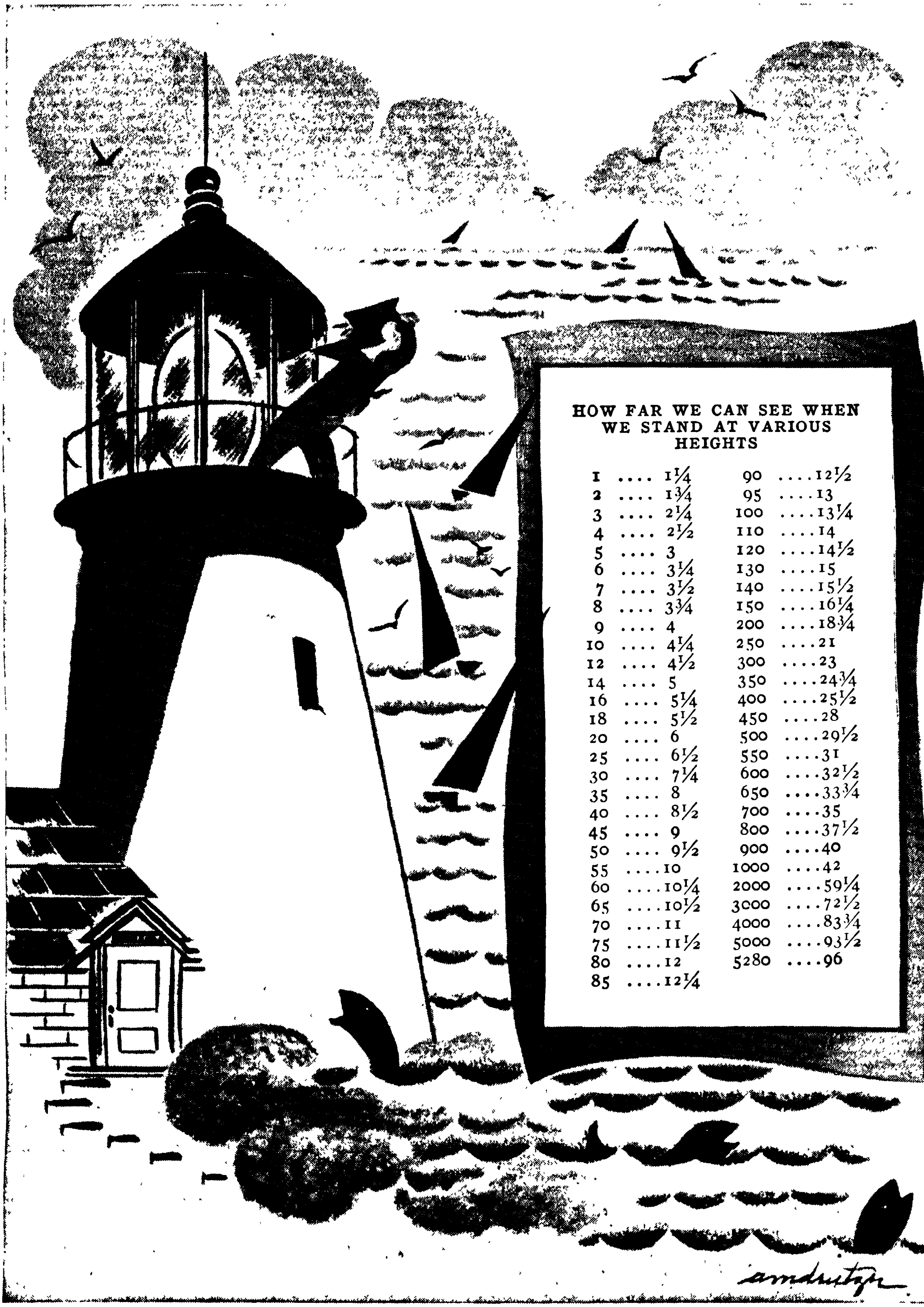
Now look along a road that stretches away from you. Right where you stand, in the middle of the road, the road may be forty feet or more in width. But as you follow the road with your eyes into the distance, its width seems to grow less and less. The lines which mark the sides of the road, which you know are parallel, seem to be coming together. You know, of course, that if you were to walk down the road a few blocks, you would find that those sides are not really coming together. They just appear to be. If you look down the road as far as you can see, there is no width to the road at all, and its two sides seem to come together in a point, which artists call the vanishing point. Every drawing has a point that is called the vanishing point. It is at this point that the straight lines which "go into" the picture—not parallel with the top or the bottom of the drawing—seem to disappear. This is an effect of what artists call perspective, and perspective is the way in which we draw a landscape, a still life or any other kind of a picture to make it look as it appears to us—with far objects properly small and near objects large.

HOW FAR CAN WE SEE?

As we stand on the seashore the sky and the sea seem to meet, way off in the distance. That meeting-place is the horizon. If we stand on a level plain we can, if there are no trees or buildings in the way, see where the end of the land seems to touch the bottom rim of the dome we call the sky. That also is the horizon.

National Film Board

Where distance lends perspective to the view.



HOW FAR WE CAN SEE WHEN WE STAND AT VARIOUS HEIGHTS

1	1¼	90	12½
2	1¾	95	13
3	2¼	100	13¼
4	2½	110	14
5	3	120	14½
6	3¼	130	15
7	3½	140	15½
8	3¾	150	16¼
9	4	200	18¾
10	4¼	250	21
12	4½	300	23
14	5	350	24¾
16	5¼	400	25½
18	5½	450	28
20	6	500	29½
25	6½	550	31
30	7¼	600	32½
35	8	650	33¾
40	8½	700	35
45	9	800	37½
50	9½	900	40
55	10	1000	42
60	10¼	2000	59¼
65	10½	3000	72½
70	11	4000	83¾
75	11½	5000	93½
80	12	5280	96
85	12¼		

The distance to the horizon depends on how high our eyes are above the level of the sea or above the level of the land across which we are looking.

A boy standing on the shore looks out on the sea from a height about four feet greater than the level of the sea—the height of his eyes above sea level. He can see just a little more than 2½ miles in front of him, and the horizon is just this far away from him. A boy on the edge of the cliff 100 feet above sea level can see about 13¼ miles to the horizon. From a lighthouse 150 feet above sea level, he could see about 16¼ miles to the horizon.

The higher up we are, the farther we can see. This is because the earth is a globe, and the land and the sea curve away from us. At a height of one mile (5,280 feet) we can see 96 miles. These figures are roughly correct, but not quite exact, because the table is simple and avoids small fractions.

WHY CAN'T WE SEE THE SPOKES OF A WHEEL WHEN IT GOES VERY FAST?

When we see an object the image it makes on the retina at the back of the eye does not flash on and off instantly. It lasts for a small fraction of a second. If a wheel goes around very fast the image made by the spokes at the different parts of their journey run into each other. So we see no different spokes at all, but only a faint blur inside the circle of the wheel.

Here is an interesting experiment. Set a wheel spinning in darkness and then turn on the electric light for just an instant. You will catch a glimpse of the spokes of the wheel all seeming still, as if the wheel were not moving. That is because you get a single clear image in the first instant of seeing.

WHY DOES AN ONION MAKE OUR EYES WATER?

Our eyes are really watering all the time, since we are always producing tears that pass over the eyeball to keep it clean. We blink to carry the tears that appear under the upper lid over the surface of the eye. These tears escape into the nose. We say that our eyes water when the tears form so fast that they can not escape quickly enough. Onions give off something to the air that excites the ends of the nerves of smell in the nose and also excites the ends of the nerves of touch in the eyeball and the eyelids. A message is sent to the brain telling the tear glands to make tears quickly; and we say that our eyes water. There is use in this, for the rapid flow of tears helps to protect the eyelids and the eyeball from the pungent stuff the onions give off.

IS THERE ANY COLOR OUR EYES CAN NOT SEE?

Yes. We may say that there are many colors that we can not see, just as there are many sounds that our human ears can not hear. We should understand that it is our own brains that translate into terms of color the waves of light which are constantly passing through space. The shortest waves which we can see come to us as blue, or violet. The longest waves we can see come to us as red. Some light-waves are long and some are short. The shortest wave-lengths are those that we see as blue or violet, and the longest are those we see as red. Beyond both ends of this visible scale of light, there are other waves which our brains do not interpret as color. We call them ultraviolet (above violet) and infrared (below red). It has been proved that some insects, such as ants, can see rays of light beyond the violet, though our eyes are blind to them. We can make use of these waves in medicine, however; and we know how to take pictures "in the dark" with infrared rays.

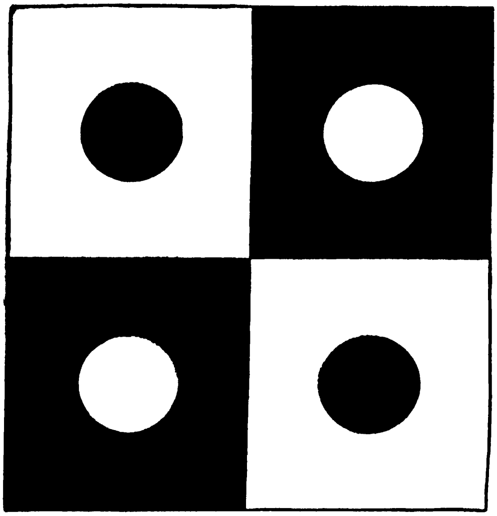
WHAT MAKES THE PUPIL OF THE EYE GROW LARGER AND SMALLER?

Around the pupil of the eye there is a ring of muscular fibers that enclose the pupil. The ring is called the iris. In front of the iris and behind it are layers of cells that contain coloring matter, and these give our eyes their color. The muscular fibers contract when we look into strong light; and the pupil, the black hole in the center of the iris, grows smaller. In darkness the iris relaxes and stretches, and the pupil grows large. This wonderful arrangement regulates the amount of light falling into the eye. In bright light the pupil is small, because we do not need so much light to see; in the dark, the pupil is large, to let in as much light as possible.

WHY DO DARK THINGS LOOK SMALLER THAN LIGHT THINGS?

When any part of the eye is excited by light, the effect of the light spreads a little around the edge of the part of the eye on which the light falls. It is as if the light at the edge of it were radiated sidewise. This effect is called irradiation.

When we see a black spot on a piece of



white paper, this process of irradiation makes the black spot appear smaller than it really is. All around the edge of the part of the eye opposite the spot, and on which the light is not falling, a little of the effect of the light from the white paper is being felt. This makes the black spot appear smaller than it really is.

When we see a white spot on a dark background, irradiation works outward from the white spot, and the white spot looks bigger than it really is.

WHY DOES HEAT MAKE THINGS SEEM TO QUIVER?

When a hot current of air passes between any object and our eyes, the object appears to quiver or shimmer. The different layers of the air are heated to different temperatures, and this causes the light to change its course constantly, and to be bent this way and that. This causes the wobbling of the light that we see as quivering or shimmering. The scientific word for this bending of light is refraction.

WHAT IS THE USE OF HAVING TWO EYES?

With two eyes we can see much better than with one eye how objects are related to each other in space. If you look at your room with one eye only, you will find that the room looks much flatter than it does with two eyes. With two eyes you can see that the chair is in front of the desk, that the waste basket is round and that the closet looks deep. Our eyes are set from about two to two-and-a-half inches from each other —measuring from center to center. The two eyes get slightly different views of any object we are looking at. Because of this, we can look around the sides of an object a little, and this helps us to see that the object is solid or deep or in front of or behind something else.

WHAT IS CATARACT OF THE EYE?

When a person grows old, the lens of the eye sometimes becomes cloudy or opaque, and does not allow the waves of light to pass through to the inner parts of the eye. This condition of the lens is known as cataract. In modern times, however, this type of blindness can be cured. It is now possible to make a small cut in the eye, then a little cut in the coat of the lens, and then, by a little squeeze, to push the lens out through the cut.

The obstacle to the light is gone when the cloudy lens is taken out, and the light can pour through to the retina. The rays, however, are not focused without the lens, and objects can not be seen properly. Spectacles with strong convex lenses must be worn, to take the place of the lenses of the eye.

DO WE SEE A THING AS SOON AS WE LOOK AT IT?

No. Seeing, like every other kind of sensation, takes time. From the instant that the light strikes the curtain at the back of our eyes—the retina—to the instant when we *see,* a few hundredths of a second must pass.

Complicated chemical changes have to take place in the living cells of the curtain at the back of the eye. Currents must run along the eye nerves, first to a group of cells in the lower part of the brain, and from them, along another set of nerves, to a group of nerve cells at the very back of the brain. Something happens in those nerve cells, and then we can *see.*

ARE PICTURES OF THE THINGS WE SEE PRINTED ON THE EYE?

Yes, but pictures of the things we see do not stay on the retina of the eye permanently, as images remain on a photographic plate. The word photograph means "light-picture," a picture printed by light on a film or plate. The retina or back part of the eye—a kind of curtain—is somewhat like a photographic film. It also contains chemical substances that are changed by light. Therefore, it is true that pictures of what

we see are printed on the retina for a very short time. But then the picture passes away to make ready for another one to take its place.

WHY DO WE SEE LIGHTS WHEN WE GET A BLOW ON THE EYE?

Usually it is light that excites the nerves of seeing, but these nerves may be excited by other things, such as a blow on the eye or even on the head. Whenever the nerves of the eye are excited in any way, we have the sensation of light. The eye nerves go to a special part of the brain that is concerned only with seeing, and therefore, no matter what it is that affects the eye nerves, the result is a sensation of light.

HOW CAN WE SEE WITH OUR EYES SHUT?

We can not see objects around us with our eyes shut, for our eyelids act like walls, or curtains, between us and the light. The eyelids do, however, allow a certain amount of light to pass through them. If you shut your eyes tight and then turn your head toward a dark corner of the room, and then toward a near-by lamp, you will discover that you can, even with your eyes shut, tell the difference between darkness and bright light.

Sometimes, with our eyes shut, we see bright colors or spots on the inside of our eyelids. This may be caused by pressure on the nerves of sight—perhaps even by the pressure of the eyelid upon the eyeball. Certain kinds of illnesses, also, will make people see little flying dark or white spots before their eyes. If you become too tired, the nerves of your eyes may become irritated, and at such times you may see spots.

The white blood cells in the eye are sometimes seen as shadows that cut off the light, or as little dark spots.

When we have been looking at a very bright object, the image of that object can often be seen when we close our eyes immediately afterwards. Sometimes the after-image is bright and sometimes dark.

WHY, IF WE LOOK AT RED, DO WE AFTERWARD SEE GREEN?

Let's try an experiment. Paint a patch of red on a piece of clean white paper. Then look steadily at this spot for a little while, and afterward at a piece of white paper. You will see a bright green spot of the same size and shape as the red spot you painted. This is another type of after-image.

Red and green are complementary colors —that is, when red and green light are mixed together they make white. When you have looked for some time at the red spot, your eye becomes tired of red. When you look at a piece of white paper afterward, your eye refuses to see the red, but, instead, sees the other color that combines with red to make the white of the paper you are looking at. And this other color is green.

In the same way, if we look at a blue spot and then turn away to white, our eyes, tired of blue, see only yellow, the color that mixes with blue to make white. Yellow and blue are also complementary colors.

THE NEXT WONDER QUESTIONS ARE ON PAGE 3975.

THE GREAT ASTRONOMERS

THE EARLY STAR GAZERS

LONG, long ago, before civilization began, the first men who roamed the earth must surely have wondered about the warm sun as it rose each morning with never failing light. It is not hard to imagine that they worshiped this life-giving body or that they gazed with reverence upon the starry skies, the Milky Way and the dancing northern lights. Nor is it difficult to guess that terror filled their hearts whenever an eclipse blotted out the sun or a fiery meteor was hurled to earth. And surely they must have asked themselves what all these strange things were.

Men have never been content merely to ask questions. Like curious children they demand answers. Guided by their own vivid imaginations these early people soon found reasons for the strange behavior of the skies. They invented fantastic stories and declared that the far-off heavenly bodies had power to affect the destinies of men.

But that was not all the vast heavens meant to these distant forefathers of ours who at the dawn of civilization might well have been called the first astronomers. In their own primitive way they began to harness the distant heavens to their own use. They learned to measure time by the sun; hunters and travelers discovered how to guide their way by the stars at night; the earliest farmers figured their planting seasons by the moon. And so it was that man began to lay the corner-stones of astronomy which long ages later inspired great minds to a scientific study of the stars—a study which was finally to explain away all the superstitions that haunted the skies.

Three thousand years before the birth of Christ (about the time written history began) in Babylonia (Chaldea) and Egypt, in India and China, many uses of astronomy were being developed. From their careful studies of the sun the Egyptians counted 365 days to the year; the heavenly bodies were used

The famous Greek astronomer, Ptolemy, whose ideas of the universe were accepted for hundreds of years.

in measuring land and planning buildings. Babylonia was the mother-country of astrology, which preceded astronomy. There the seven-day week was marked off, and the day, with twelve double hours. As far back as 1200 B.C. the Phoenicians steered their way by the sun and stars across the open sea. And about this same time the Chaldeans, though not with the accuracy of modern astronomers, were already foretelling eclipses. In these early years before the birth of Christ, the Greeks gave a special name to five of the stars which move in the sky. These they called planets—the Greek word for wanderers.

Although many attempts were made to explain the skies, it was not until the time of Thales, who lived from about 640 to about 550 B.C., that astronomy was first studied as a science. Thales was born in Miletus, a Greek city in Asia Minor, but he traveled much in Greece proper, Crete and Egypt. One of the seven wise men of ancient Greece, he was the first to realize that the stars were more than mere signs in the sky to be translated into fantastic meanings. Thales founded the earliest school of Greek philos-

ophers; he developed geometry and put it to such practical uses as measuring the height of trees or buildings and determining the distance of ships at sea. He drew maps of the most noticeable stars as they appeared in the heavens—a task which no man before him had ever attempted. In 585 B.C. he foretold an eclipse of the sun and when the heavens proved the amazing accuracy of his prediction he rose to a fame that has lived through the ages.

About two hundred years after the death of Thales, another distinguished school of Greek learning began to flourish outside Greece proper, at Alexandria, in Egypt. There the study of the heavens was advanced.

Aristarchus, who lived from 310 to 250 B.C., was a Greek from the island of Samos. He was a teacher at Alexandria. He was the first to proclaim that the sun stands still and the earth revolves around it. He also taught the theory of an earlier Alexandrian, Heraclides, that the earth spins on its own axis. Eratosthenes (about 350 B.C.) estimated the size of the earth, and reached a figure within only a few hundred miles from the truth.

HOW A LINE DRAWN IN THE SAND HELPED TO CHART THE SUN'S COURSE

Timocharis, who lived about 300 B.C., drew a line from east to west across a sandy plain, and watched the sun's rising and setting north and south of the line. The days in which the sun rose and set exactly on the line were the equinoxes. The sun's annual course among the stars was also charted at the school of Alexandria.

Hipparchus, another Alexandrian Greek, born about 160 B.C., was one of the two greatest astronomers of the ancient world. He built upon the work of the earlier astronomers and he was famous for his accurate observations of the skies and his discovery of the precession of the equinoxes caused by the wobbling of the earth on its axis. According to their brightness he classified and made a list of over one thousand fixed stars, basing some of his work on the observations of former star-gazers. He developed that branch of mathematics known as trigonometry which he used in his accurate calculations of the length of the seasons and the motions of the planets and moon—truly great discoveries for his time, when we think that he worked without the aid of any modern instruments.

The other great astronomer of the ancient world was Claudius Ptolemaeus, known to history as Ptolemy. He was a Greek born in the second century after Christ. He lived in Alexandria, and was by far the most brilliant teacher of the Alexandrian school. He made a famous geography of the world with maps. He developed the study of trigonometry as an aid to navigation and astronomy. Yet this scholar retarded the development of scientific astronomy in the centuries that followed his time. Unfortunately for progress the world accepted without question his teachings that the earth was stationary—the center of the universe around which the sun, the moon and the planets all revolved. It was not until the sixteenth century that anyone doubted his findings and proved them wrong.

HOW A GREAT ASTRONOMER LED MEN INTO ERROR FOR HUNDREDS OF YEARS

However, all Ptolemy's deductions were not incorrect, for he gave to the world the theory of the moon's motion as it travels in its orbit; and he discovered that light from a distant star changes its course upon entering the earth's atmosphere. Ptolemy wrote a book on astronomy, setting forth all that was known and believed about the heavens in his day. It became the textbook of astronomy for hundreds of years. In the ninth century Arab scholars translated it into their language and called it *Al Magisti* (The Greatest). From Arabic it was translated back into Greek and Latin and so into other languages, but it has retained a Latin form of its Arabic name, *Almagestum*. English writers call it the ALMAGEST.

After the death of Ptolemy we find few important names in the history of astronomy. Those who stand out are Arabians, for they were the world's greatest scholars in all branches of science, especially from the eighth to the twelfth centuries. Al Batani (about 880 A.D.), Ibn Junis (about 1000 A.D.), Abul Wefa (about 1000 A.D.) and Ulugh Beg (he belonged to a later day—around 1400) were illustrious Arabic scholars who made contributions to the study of astronomy, chiefly through improvement of mathematical measurements.

Omar Khayyam, the Persian (who lived around 1100), is best known to the world today as a poet. He was a serious scholar and astronomer, however. He improved the Persian calendar, and did much work in mathematics. In his early life he was a maker of tents, and the name Khayyam, tent-maker, was given to him then.

The next celebrated astronomer was a

European, whom we know by the Latin form of his Polish name, Nicolaus Copernicus. He was the son of a Polish father and a German mother. He lived from 1473 to 1543, and spent most of his life in study. He was educated at the universities of Cracow, Bologna, Padua and Ferrara, studying medicine, law (especially church law), mathematics and astronomy.

Copernicus it was who dared to upset the old error of Ptolemy which the world had clung to for so many hundreds of years. For Copernicus said that the earth was not the center of the universe, but one of the planets of the solar system spinning about its axis every twenty-four hours, and revolving around the sun every year. Some notion of this had been put forward by the pupils of the ancient Greek philosopher, Pythagoras; but few people listened, and the theory had all but died out of the memory of men. This was called the Pythagorean theory, because some of his pupils put it forward. Pythagoras himself did not believe it.

COPERNICUS UPSET THE OLD IDEA THAT THE EARTH WAS THE CENTER OF THE UNIVERSE

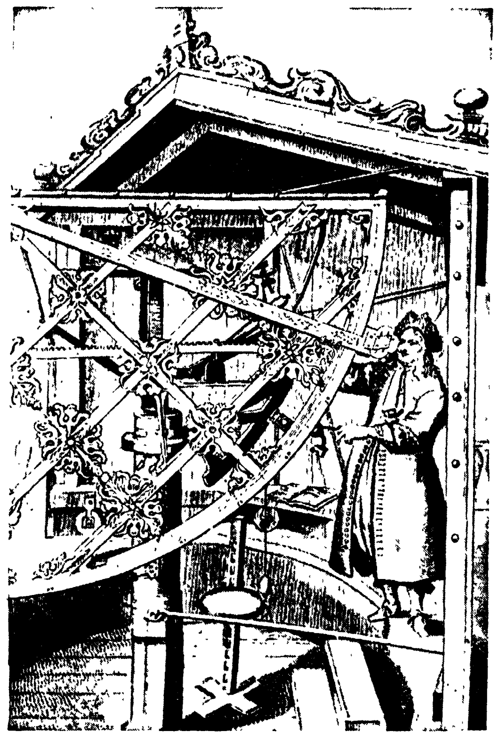
Copernicus studied and observed and read and thought and figured until he knew that Ptolemy must be wrong—the earth could not be the center of the universe.

This was a daring and disturbing statement to make publicly. It turned upside down the world's thought of itself. For many years only a few scholars knew about the theories of Copernicus. Not until shortly before his death was his book published, setting down his beliefs plainly.

Even then, scant attention was paid to the book until seventy years later, at the time of Galileo.

Copernicus has properly been called the father of modern astronomy. His discoveries give impetus to a new and lasting wave of study. With these new truths to build upon, many of the puzzling secrets of the universe were soon to be explained and the study of scientific astronomy was to reach undreamed-of heights.

Many students have to struggle against poverty, but the famous Danish astronomer, Tycho Brahe, was faced with the struggle against riches. He was born in the Danish (now Swedish) province of Scania in 1546, and his rich family planned a lawyer's career for their son. Little did it matter that Brahe had no feeling for this profession. He was sent to law school anyway. But during those years at school his



The Bettmann Archive

Tycho Brahe of Denmark at work in his observatory, the "Fortress of Heaven," at Copenhagen.

mind was elsewhere, in the distant corners of the unexplored sky. Watching through his bedroom window, with only a pair of compasses to help him, he spent long hours delving into the mysteries of the universe. Handicapped as he was without instruments, he discovered errors in the figures of the most celebrated astronomers. In spite of the interference of his family, he became famous at the early age of thirty; and when Frederick II, king of Denmark, heard of this talented young man he built a fine observatory for Brahe and gave him a salary.

There, in the "Fortress of the Heavens" as the observatory was called, Tycho Brahe worked for twenty years. He studied and improved upon some of the works of Copernicus, though he could never fully accept the Copernican theory. He reasoned, and rightly, that if the earth revolves around the sun there should be an apparent shift of the stars; this he could not detect with his instruments. He devised a theory of his own—that the moon and sun revolve about the spinning earth, and that all the other planets

revolve about the sun. Mistaken though Tycho Brahe was about the earth's place in the solar system, he was a great astronomer and gave to the world new discoveries about the laws governing the motions of the moon. He helped the advancement of knowledge about the comets, and he worked out with surprising accuracy the positions of some of the most important stars.

When Frederick II died, Brahe's fortunes were greatly changed. The new king did not befriend him. His salary stopped, and the use of the observatory was taken away from him. Heartbroken, he left the country and went to Prague. Sad though it may have been for Tycho Brahe, the world was to benefit from his misfortunes, for in Prague he met and influenced a young man, Johannes Kepler, who was to become a greater astronomer than he. Brahe tutored this man, and at his death in 1601 left all his papers and instruments to Kepler. Brahe's observations were made possible by the fine instruments he possessed. He designed them himself, and they far exceeded in degree of perfection any before his time. Perhaps his greatest contributions were the accurate observations of the positions of the planets. With them Kepler discovered the laws of planetary motions about which we shall speak in a moment. Without the benefit of Tycho Brahe's observations, Kepler could not have made his conclusions.

Johannes Kepler was a German. He was born in Württemberg in December, 1571, and died in 1630. At the early age of twenty-two he was appointed a teacher of mathematics at Gratz, and while there spent most of his spare time learning astronomy. From this time on he devoted the rest of his life to the study of the skies. Kepler was intrigued by the hitherto undiscovered laws that rule the motions of the planets around the sun. He devoted long years of study to this one problem; finally he discovered the answer.

Kepler's discoveries of these laws enable us to locate any planet in its orbit at any given time. He also discovered that the planets do not travel in circles, but in ellipses. This truth showed that Copernicus was basically right. Kepler's laws became the foundation of modern astronomy.

We come now to the illustrious astronomer, Galileo Galilei, who was born at Pisa on February 18, 1564—a memorable date in history, for on that day the equally famous Italian artist, Michelangelo, died.

As a boy Galileo showed outstanding ability in several fields. He was clever at mathematics and displayed fine talents for art and music. His family wished him to study medicine, and he did so for a year at Pisa. But he wanted to become an artist. He soon learned that a good artist would profit by a knowledge of geometry. He applied himself to the study of mathematics and as he progressed, new and more interesting fields opened up to him. When finally Galileo was asked to lecture on mathematics at Pisa, he gave up all thoughts of being an artist.

While a student of medicine he had one day watched a lamp hung on a chain from the dome of Pisa Cathedral swinging back and forth. Thoughtfully he studied it, timing its swing with his pulse. He learned that the length of the swing of a pendulum has no effect on the time it takes to make one swing. On this principle of the pendulum which he discovered, clocks and several other tools are based. The first such time-keeping instrument was a pulse-counter (pulsometer).

People of Galileo's day still believed in Ptolemy's ideas of the heavens, and in the works of the ancient Greek thinker, Aristotle, who stands among the world's most learned men, although all he said was not correct. Galileo was the first to doubt Aristotle's figures on the speed of falling objects. The great Greek had believed that heavier objects fall faster than lighter ones. Galileo showed this is untrue. He dropped two objects of different weights

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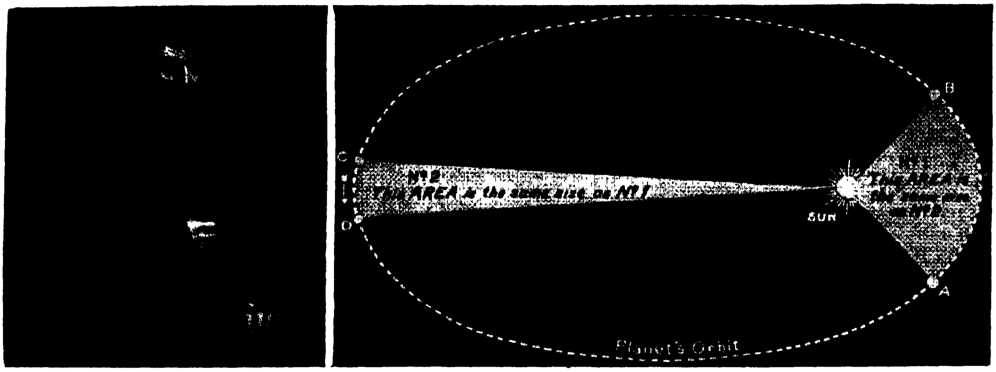
Copernicus, "father of modern astronomy."



Johannes Kepler, the German astronomer, showed in his famous second law of motion that the speed of a planet moving around the sun varies. An imaginary line joining the center of the planet to the center of the sun sweeps over equal areas in equal times. The diagram shows that a planet moving around the sun from A to B takes no longer than a planet moving from C to D, since the areas marked 1 and 2 are equal.

from the Leaning Tower of Pisa, and saw that they fell at the same velocity. Thus he proved that all objects fall at the same velocity (except for the resistance of the air) —an amazing discovery.

Because Galileo upset so many of the accepted ideas of his time, and partly because of his manner of argument, he became very unpopular. He was forced to leave Pisa in 1592 and take a position in Padua. There he lectured with brilliant success. Students journeyed from long distances to attend his classes. In 1610 he left Padua for Florence, where he spent most of his life thereafter.

Early in his studies Galileo had believed in Ptolemy's system, but later he saw that Copernicus was right. To a world not yet ready for the truth (even though Copernicus had been dead for seventy years), Galileo dared to teach the Copernican theory that the earth moves around the sun.

Galileo's most famous contribution to astronomy was probably through his development of the telescope. In 1609 he heard of a magnifying toy which was being sold by a Dutch spectacle-maker for the amusement of children. At once Galileo saw the possibilities of such a thing if it could be used to bring the skies closer to man. Without delay he began work on a telescope. When he had made an instrument that enlarged objects thirty diameters he turned it toward the skies. Immediately he saw countless stars that had never been seen before. He learned that the Milky Way is made up of a vast number of tiny stars which can not be seen by the naked eye.

Galileo studied the moon through his telescope and found that it is not smooth like a rubber ball but that its surface is rough and mountainous like the earth. When he turned the telescope on Jupiter you can imagine his surprise at finding four moons circling around that planet.

Pointing his instrument for the first time toward the sun, Galileo saw that it, too, is not the smooth, shining disc men had believed it to be. To his amazement he found that there are dark patches on the glowing surface—sun-spots—which no man had ever seen before. By means of these dark spots Galileo made an important contribution to astronomy. He observed that certain of these patches disappear only to reappear again in about twenty-eight days. Thus he concluded that the sun, like the earth, turns on its axis, but takes twenty-eight (or so) times as long as the earth to make a complete turn.

Galileo was a genius, and a very great one, although he made a number of errors. Like many geniuses he clung to his errors as stubbornly as to his discoveries of the truth. During his lifetime he was a brilliant, exciting personality, and in the centuries since his death many stories have been told about him. His whole life was an adventure in learning.

We have seen how he was forced to leave Pisa and go to Padua in 1592. He remained in Padua for almost eighteen years, teaching and studying. It was just at the end of his time in Padua that he made his telescope and saw many wonders of the heavens. His fame blossomed almost overnight. Curious people by the hundreds thronged to peer through his telescope, and now everything that he taught seemed very important. He began to say that the Bible was his authority for asserting that the earth moved around the sun. Church dignitaries, in alarm, took

issue with him, and Galileo was brought to trial. His teachings of the Copernican system were condemned as being not proved in Holy Writ. The trial took place in 1615.

Galileo promised not to spread the theory and for a number of years he kept his promise. In 1632, however, he brought out a clever, sarcastic book on the theories of the universe, in which he put forward the Copernican system. He was again brought

Culver Service

When the great Italian astronomer, Galileo, was seventy-four years old, and already growing blind, he was visited by John Milton. The English poet, then thirty years of age, while traveling in Italy, paid homage to the famous scientist. He saw Galileo's telescope, which he afterwards spoke of as "the optik tube."

to trial by the Church, and this time was imprisoned for twenty-two days. The second trial was for breach of contract. Galileo was forced to renounce solemnly his statement that the earth travels round the sun. Years afterward the legend arose that as he went from the courtroom he muttered, "All the same, it does move." There is no basis for this story, though, as we know, Galileo was right. The world is often slow to accept new ideas and changes.

After his release Galileo continued to work at his discoveries and to write books that were of lasting importance. Toward the end of his life Galileo became blind and his explorations of the vast heavens came to a close. In 1642 he died and was buried without any special honor.

Jeremiah Horrocks was born near Liverpool in 1619 and died a famous man only twenty-two years later. Although a poor curate, this strange young genius found time to study the stars. According to his figures he predicted that Venus would cross the sun on the afternoon of November 24, 1639. When this long-awaited day arrived, Horrocks darkened his room, allowing only a narrow ray of the sun's light to shine through an opening in the shutter. He placed his small, inexpensive telescope in the path of this ray and adjusted it until he saw the image of the sun on a sheet of white paper. Then, as he eagerly watched, he knew the thrill of discovery, for he saw the disc of Venus pass over the disc of the sun—the first man to witness this occurrence.

On Christmas Day, 1642, another Englishman was born who was to reach gigantic heights in the scientific world. He was to carry on the work of Copernicus, Kepler and

Galileo. This man was Sir Isaac Newton.

As a child Isaac showed no signs of genius, except certain mechanical talents. He was a sickly boy and devoted much of his time to inventing such toys as windmills and kites. It was not until he began the study of mathematics that his hidden genius took root and started to grow. He attended Cambridge University, and worked upon the problems that so deeply interested him. Kepler had shown that the planets wheel about the sun, held in their orbits by some mysterious force, and that Jupiter exercised a similar power

Galileo, watching a hanging lamp in Pisa Cathedral, noted that no matter how far it swung, it took the same time to complete a swing.

over its satellites. Newton saw that the earth likewise controls its own satellite, the moon. His mind sought for the explanation of this harmony, this wonderful, universal law. One day, sitting in his grandmother's garden, he saw an apple fall from a tree and drop upon the ground. A window in his mind seemed to open at once and he understood the great law of gravitation that rules the universe, and all things in it, great and small. (We tell you about this law on page 739.)

When Newton first tried to apply his law of gravitation to the motion of the moon he was unable to make the facts agree with the theory. He was unable to prove that a body such as the earth attracts distant objects as though all its mass were concentrated at its center. Before he could prove this he had to invent a new kind of mathematics—today we call it calculus.

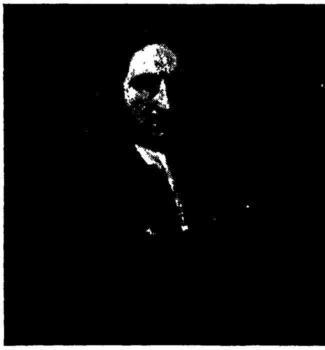
Newton made many other important contributions to science—his laws of motion, advances in mathematics and the breaking up of white light into its separate colors, what is now called spectrum analysis. He also made studies of telescopes.

We are told that an apple falling from a tree gave Isaac Newton the clue to the great law of gravitation that rules the universe.

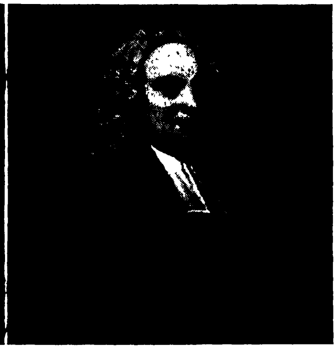
Many honors came to Isaac Newton. Queen Anne knighted him, he was elected to learned societies and to Parliament. He was made Warden, then Master, of the Mint. These positions carried salaries that relieved him of financial worry, so he could continue his scientific work. When he died in 1727, at the age of eighty-five, he was buried in Westminster Abbey, among the great of his nation. Yet no worldly honors could do justice to this man, who set forward so far the clock of human thought.

Article prepared with the assistance of Roy K. Marshall, Acting Director, Fels Planetarium, Philadelphia.

THE MEN WHO MAPPED THE SKIES



Edmund Halley, who studied comets, and for whom one comet is named.



James Bradley, an Astronomer Royal, discovered the aberration of light.

One of the uses of astronomy is in the work of navigation; by observing the stars it is possible for a master to learn where his ship is on a trackless ocean. England has always been one of the greatest nations of seafarers; and in 1675 there was established at Greenwich, a suburb of London, what is called the Royal Observatory. The head of the observatory is called the Astronomer Royal. The first man to hold this position was John Flamsteed (1646-1720). His special task was to learn more about the stars in their courses in order to give better aid to sailors. To this day much of the work of the Royal Observatory is devoted to this practical purpose.

The second Astronomer Royal was Edmund Halley (1656-1742), a close friend of Sir Isaac Newton. He kept Newton from forgetting one piece of work while turning aside to do something else. Newton never liked to stop working long enough to write down what he had been doing, and Halley was the one who finally arranged for Newton's great book, called the PRINCIPIA, to be printed and distributed.

However, Halley was far more than just a prod for Newton; he was a very capable astronomer in his own right. When only a young man, he saw that it was important to know as much about the southern sky, invisible from England, as it was to know all about the northern sky. His father gave him a salary and obtained various letters of introduction that made it possible for Halley to go to the island of St. Helena to make observations of the exact positions of the southern stars. However, he found that St. Helena was not a very good spot from which to study the heavens, so he remained only one year on the island (which nearly a century and a half later was Napoleon's place of exile). During that one year Halley had accomplished much, however, and on his return to England his future as an astronomer was assured.

He was the first man to become interested in determining how the compass needle behaves in various parts of the world. Between 1694 and 1700 he traveled to the South Seas and deep down toward the Antarctic region; and he published a map in which the variation of the needle from the true line of north and south was indicated, for the use of mariners. (See page 4973 for an explanation of this.)

People who are not astronomers remember his name particularly in connection with a great comet. Halley observed several comets and studied the observations of others that had appeared before his time. He determined their paths and at last was able to say that several comets had followed the same path at intervals of about seventy-six years; he decided that they were all the same comet, coming back time and again. He announced that the comet he saw in 1682 would come again in 1758. It did return when he said it would, years after his death; it came again in 1835 and 1910, and Halley's comet, as it is now called, will return in 1986.

Halley was the first man to show that the stars are not really fixed in position as they had been thought to be through all the ages. He saw that a few of them had changed their places with respect to each other in the almost sixteen centuries since the time of Ptolemy. The study of these proper motions, as they are called, has taken much of the time of many astronomers since Halley's day; and now we know all about the motions of many thousands of stars.

The great Danish astronomer Tycho Brahe had been unwilling to accept the Copernican theory of the motion of the earth around the sun. Here was his reason: Tycho saw that if the earth swings from one side of the sun to the other the stars must appear to shift back and forth, and Tycho was unable to observe such shifts with his instruments. Other astronomers were content to say that the stars are so distant that the tiny shifts

could not be measured with the instruments of Tycho.

With the invention of the telescope, the power to measure tiny distances in the sky was greatly increased and many astronomers tried to discover these annual shifts of the stars. James Bradley (1693-1762), the third Astronomer Royal, tried, but, like all the others, he too failed. However, in failing he found something else called the aberration of light. Just as we must tilt an umbrella a little ahead of us to avoid getting wet as we walk through the rain, so the telescope must be tilted a little ahead in the direction of the earth's motion in order to catch the light of a star. If we were not moving, this would not be true; so Bradley was the first to prove in some way that the earth is in motion around the sun.

ONE OF THE GREAT ASTRONOMERS BEGAN HIS CAREER AS A MUSIC TEACHER

The greatest observer of all time was Frederick William Herschel (1738-1822). Born in Hanover, Germany, he went to England when he was nineteen years old. He had received a musical education and he earned his living by playing the oboe and the organ and by giving music lessons to others. He was only an amateur astronomer, looking at the stars because he loved them. He borrowed a telescope, but it was not good enough for him, so he set to work to make one for himself. Even today many astronomers design and sometimes even build their own instruments.

On March 13, 1781, with a telescope that he had made, Herschel discovered a new planet, the first one to be found in historic times. While he at first wanted to call the new planet Georgium Sidus—George's Star—in honor of King George III, he was finally persuaded by other astronomers to give it a mythological name like the others; the planet was named Uranus.

William Herschel became famous almost at once. He was called to the court of King George III and persuaded to give up his music and become a professional astronomer. The King gave him a salary, but it was not nearly enough to support William, his brother Alexander and his devoted sister Caroline. It would perhaps have been enough if William had not wanted to keep on building bigger and better telescopes. So he built many small telescopes to sell to the rich people of the court and even in foreign lands. This he did until 1788, when he was fortunate in finding a wife who had enough money to care for him and his telescopes.

Caroline Herschel had been the housekeeper as well as business manager and general assistant to her brother. She moved to another home when William married, but she continued as his assistant until the end of his life. Sometimes her brother would not stop working on his telescopes even to eat his lunch; on one occasion, when he worked for more than fifteen hours without stopping, Caroline fed him with a spoon as he worked.

The Italian Galileo had discovered four moons of Jupiter and had seen something curious about Saturn. In 1655 the Dutch scientist Christiaan Huygens (1629-95) had found a moon of Saturn, and seven years later discovered that the strange appearance about Saturn was a thin, flat set of rings like the brim of a hat. Between 1671 and 1684, the Frenchman Domenico Cassini (1625-1712) found four more moons of Saturn.

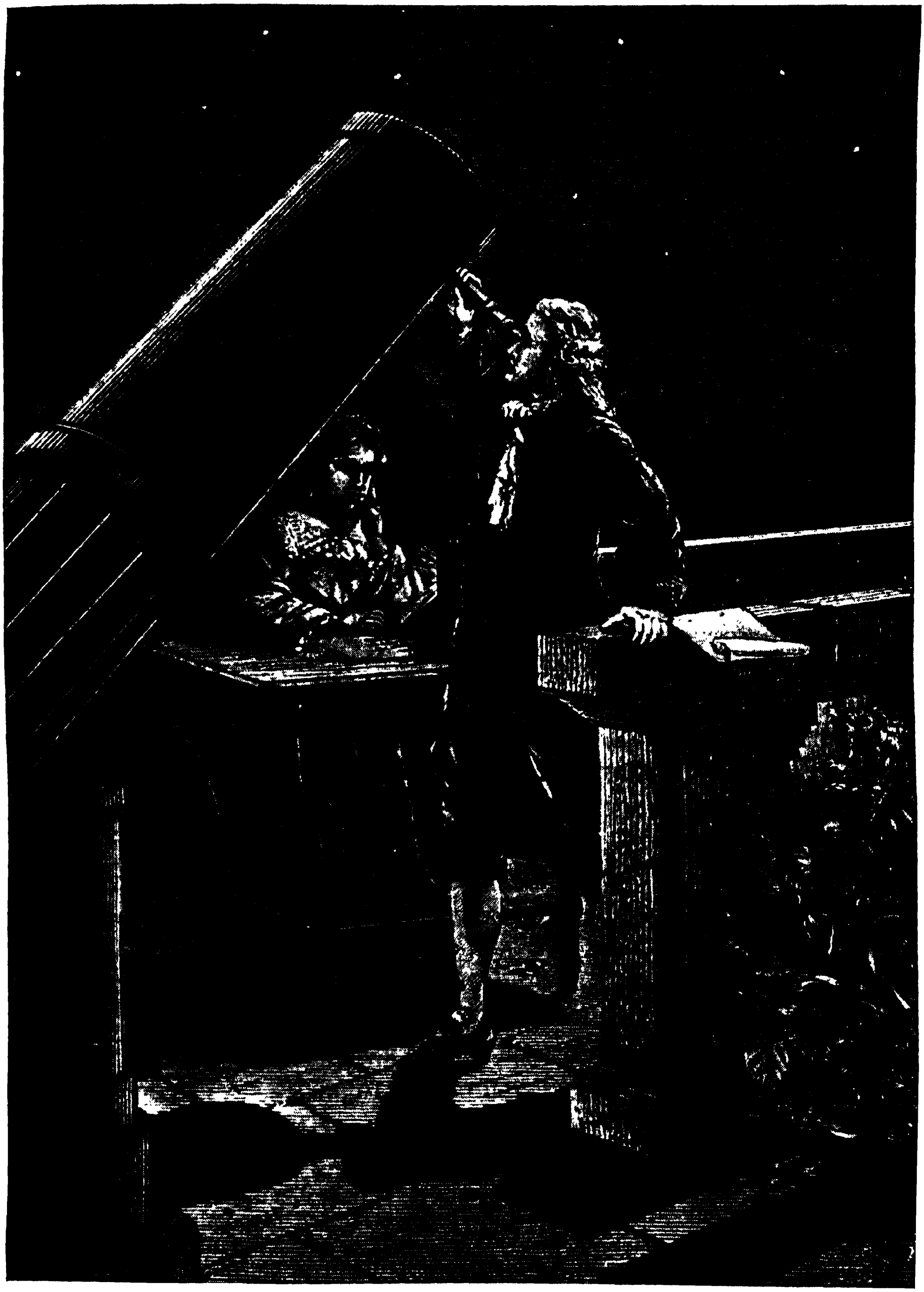
WILLIAM HERSCHEL STUDIED DOUBLE STARS TO EXPLAIN THE EARTH AND THE SUN

By 1789, Sir William Herschel (for he was knighted by the king) had made a telescope four feet across, by far the largest in the world at the time. On the first night it was used, he discovered a sixth moon of Saturn and three weeks later he found the seventh. In 1787, with a smaller telescope, he had discovered two moons of Uranus, the new planet he had added to the sun's family.

Such discoveries were to him less important than the things he found as he patiently examined, time after time, every little spot in all the heavens visible from England. He found 2,500 nebulae and more than 800 double stars. He was looking for double stars because he thought that perhaps because of the earth's motion around the sun he could see one of the stars of such a pair change its position with respect to its companion star. He was surprised to find that many of these pairs were actual binary stars, revolving around each other in perfect accordance with Newton's law of gravitation.

Herschel was even a little disappointed when he saw that his original plan would not work out; later, however, he saw the importance of the binary stars and he said, "I am like Saul, who went out to seek his father's asses and found a kingdom." It has often happened that an astronomer has been disappointed in one thing but his work has yielded an even more important result than the one he first sought.

Herschel thought that the proper motions



William Herschel, a great observer of the stars. Here the artist pictures him discovering the planet Uranus

of the stars, discovered by Halley, could be partially explained by a motion of the sun through space. As a result of his studies, he was able to say that the sun is heading in the direction of the star group Hercules, not far from the bright summer star Vega. As it travels along with a speed of almost 45,000 miles an hour, the sun carries with it the earth and all the other planets revolving around it.

AS WE LOOK TOWARD THE EDGE OF OUR UNIVERSE WE SEE THE "MILKY WAY"

Sir William was very much interested in finding the shape and size of our universe. He discovered from his observations what a few thinkers before his time had suggested, that we live in a flattened crowd of stars, the whole system shaped like two saucers put rim to rim. We (the bodies of our solar system) are a little to one side of the middle of this lens-shaped swarm of stars; and as we look toward the edge of it (where the rims of the saucers touch) we see the most stars. This is what produces the appearance of the Milky Way in the heavens.

When William was busy at his calculating or his thinking, his sister Caroline was allowed to use one of the telescopes for her own amusement. With it she discovered eight comets; one of them she found in 1788 and it came back again for the first time in 1939. There are some comets known that have periods of thousands of years; this comet of Caroline Herschel's is the one with the longest period that had been seen on two occasions. It will not return until the year 2090.

Caroline and Lady Herschel (William's wife) were good friends and Caroline was very fond of her nephew, John. After the death of Sir William, Caroline went back to Germany, but she corresponded with John (1792-1871) who became a worthy son to carry on his illustrious father's work. He became Sir John Herschel. He took a telescope to the Cape of Good Hope so that he could see the sky not visible from England. He remained in South Africa for five years, discovering 1,200 stars and 1,500 nebulae. In the sky of England he found 500 nebulae his father had missed and 3,000 more double stars.

On January 1, 1801, an astronomer of Palermo, Giuseppe Piazzi (1746-1826), noticed a little star-like object that seemed to change its position during the next few days. He fell ill, and it was several weeks before the news of his observations came to a German mathematician of Göttingen, Carl Friedrich Gauss (1777-1855), who was interested in the motions of the planets. From only the first few observations made by Piazzi, Gauss was able to predict the future positions of the moving object; on December 31, 1801, it was found again. It was recognized as a new planet and given the name Ceres, for the goddess of the harvest. It was the first to be found of the family of almost 2,000 known minor planets or asteroids. Ceres is the largest, less than 500 miles in diameter. Some very faint ones discovered in more recent times are only one mile or less in diameter, no bigger than a small mountain. There were others found in 1802, 1804, 1807, 1845 and 1847; since that time, not one year has passed without the discovery of at least one of these little planets. Their paths lie mainly between the orbits of Mars and Jupiter, although some of them spill over one side of that track or the other.

LAPLACE, A BRILLIANT FRENCHMAN, SHOWED THAT OUR SOLAR SYSTEM IS STEADY

A French astronomer, Pierre Simon de Laplace (1749-1827) has been called the Newton of France. He was a brilliant mathematician. In fact, Napoleon gave him a position in the government as a reward for his services to science, but later removed Laplace saying that he had tried to conduct government by mathematics. Nevertheless, Laplace secured many high honors. He was a member of the Academy of Sciences, president of the French Academy, member of the commission that established the metric system, senator and chancellor. After the downfall of Napoleon, when the monarchy was restored to France, Laplace was made a marquis. His contributions to science were many. He proved that our solar system is essentially stable. Newton had feared that it might be deranged in time, due to its own action. Laplace showed that any irregularities due to the action of planets on each other, or to comets, are only temporary, and correct themselves.

Friedrich Wilhelm Bessel (1784-1846) worked at the Prussian king's observatory at Königsberg; he was the first man to publish a good value for the distance of a star, 61 Cygni. He gave his result in 1838, at about the same time as Friedrich Georg Wilhelm Struve (1793-1864), of Dorpat and Pulkova, Russia, announced the distance of the star Vega. In the following year Thomas Henderson (1798-1844), from observations at the Cape of Good Hope, announced the

distance of the star Alpha Centauri. These star distances were measured by observing the shifts of the stars as the earth revolves around the sun. They are the very shifts that Tycho Brahe and Bradley looked for and could not find. Now there could be no doubt that the theory of Copernicus was true.

The positions of Bessel and of Struve were somewhat similar because each was the astronomer for a king. But whereas the Tsar Nicholas had spent a lavish amount of money on the fine new observatory at Pulkova, the German king spent hardly enough money on Bessel's observatory to keep the instruments in repair. It is said that one time the Prussian ruler visited the fine Russian observatory at Pulkova, and as Struve showed him all the instruments he kept exclaiming, "Ah, how fine! If my Bessel could have this to work with!" Upon his return to Königsberg, he gave Bessel a medal for doing such good work with such inferior instruments!

Not quite one hundred years after the Russian emperor built the fine Pulkova observatory for F. G. W. Struve, the astronomer's great-grandson, Otto Struve (1897-), became the director of the Yerkes Observatory of the University of Chicago; a few years later he became director also of the McDonald Observatory of the University of Texas. He is the sixth Struve in four generations to become known as one of the leading astronomers of his time.

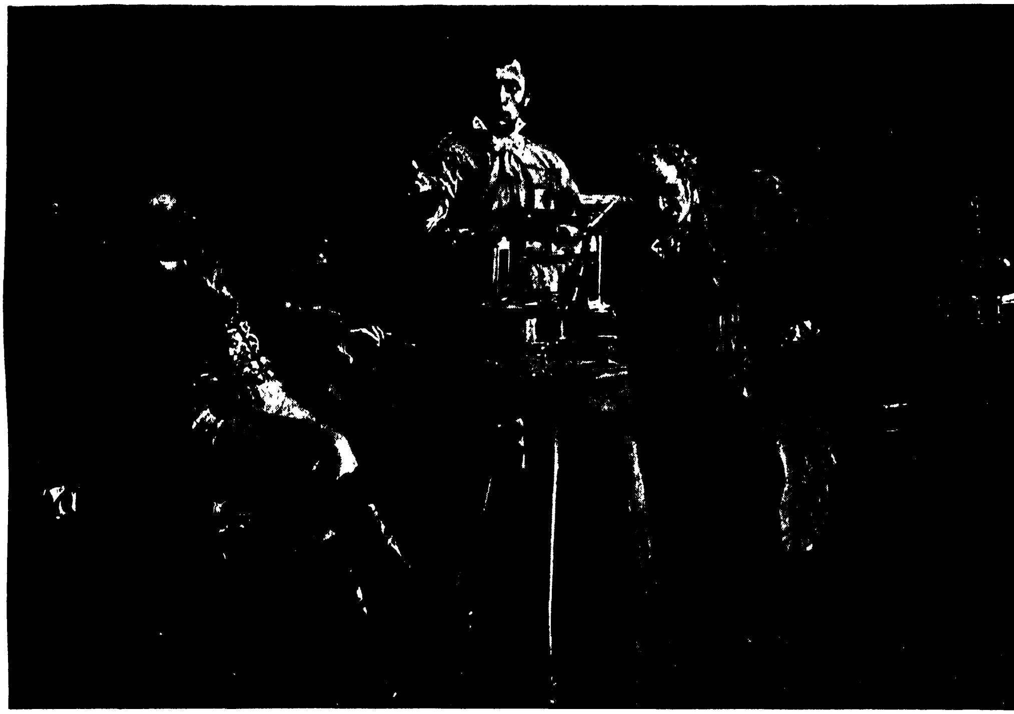
A very great French astronomer was Pierre Laplace.

HOW PHOTOGRAPHY HELPS TO MEASURE THE DISTANCES OF THE STARS

The earliest measures of star distances were made visually, with the astronomer's eye at the telescope, making very careful measurements. When photography was applied to this problem, about 1900, the results became much more accurate. Today, largely through the efforts of an American astronomer, Frank Schlesinger (1871-1943), the distances of thousands of stars are known. First at the Yerkes Observatory, then at Allegheny and last at Yale, Schlesinger set the pattern of the work; other astronomers all over the world followed his methods and helped to measure the distances of the stars.

At Bonn, Germany, the birthplace of Beethoven, the astronomer Friedrich Wilhelm August Argelander (1799-1875) and his assistants, particularly Eduard Schönfeld (1828-91), made the last great visual star map, containing nearly half a million stars. Now such mapping is done by making photographs at frequent intervals to see whether changes have occurred. Photography is much quicker and more accurate than the older method of mapping the heavens. The idea of photographing the stars for making maps of the sky came to astronomers as a result of the great number of stars appearing on the pictures that were made in South Africa of a very great comet observed in 1882.

One of the things Sir Isaac Newton did (in 1665) was to prove that light of different wave-lengths (different colors) is bent by different amounts as it passes through glass or other transparent material. William Hyde Wollaston (1766-1828), of London, and Joseph Fraunhofer (1787-1826), of Munich, studied the spectrum of the sun—the rainbow-colored band of light produced when sunlight passes through a glass prism. They found that there are thin dark lines or missing colors in the spectrum. In 1859, Gustav Robert Kirchhoff (1824-87), of Heidelberg, explained these lines by showing in the laboratory that each chemical element produces a different set of lines. These lines in the spectrum of the sun or any other gaseous body tell us what the gases of the body are made of. In this way we know that the most distant stars contain hydrogen, carbon, nitrogen, oxygen, calcium, iron; these and many other materials known on earth exist in the stars, and there is nothing



Joseph Fraunhofer, by study of dark lines in the sun's spectrum, helped to show what sun and stars are made of.

new under the sun, in the sun or beyond it. Indeed, these are the same materials that make up the human body, so we are made up of the same stuff as the stars; we are star dust.

In Munich, one summer day in 1801, two old houses in the poor part of the town fell down. Several people were killed by the accident; there was one survivor, a fourteen-year-old orphan boy whose name was Joseph Fraunhofer. He was badly injured but he soon felt that perhaps the accident had not been so bad for him, for a very important man who saw him rescued gave him eighteen ducats, a large sum of money for those days. Part of the money he spent on books and a small machine for grinding pieces of glass into lenses; the rest of the money purchased his freedom from his cruel master, a mirror-maker, who had taken the boy in as a helper when his parents had died.

Fraunhofer became one of the most celebrated telescope-makers of all time. He taught others to do the same fine work, and he and his successors furnished large telescopes to observatories in many countries, including the United States. Henry Fitz, Jr. (1808-63), of New York, made his first lens from the thick bottom of a broken drinking-glass; later he made fine telescopes whose mountings were very closely copied from the excellent designs of Fraunhofer.

The work of Henry Fitz was surpassed by that of Alvan G. Clark (1832-96) and his brother and his father, a portrait painter of Cambridge, Massachusetts. It all began when the brother, George Bassett Clark, at the age of seventeen, was a student at Phillips Academy at Andover, Massachusetts. The dinner bell broke one day and young Clark, remembering that Newton had made telescope mirrors of bell metal, collected the fragments, melted them into a five-inch disc, and started to work. His father, Alvan Clark, Senior, grew interested, then his brother, who became the best of them all. The largest telescope lens in the world, the forty-inch objective of the telescope at the Yerkes Observatory on Lake Geneva in Wisconsin, was made by Alvan G. Clark and his associates in 1896.

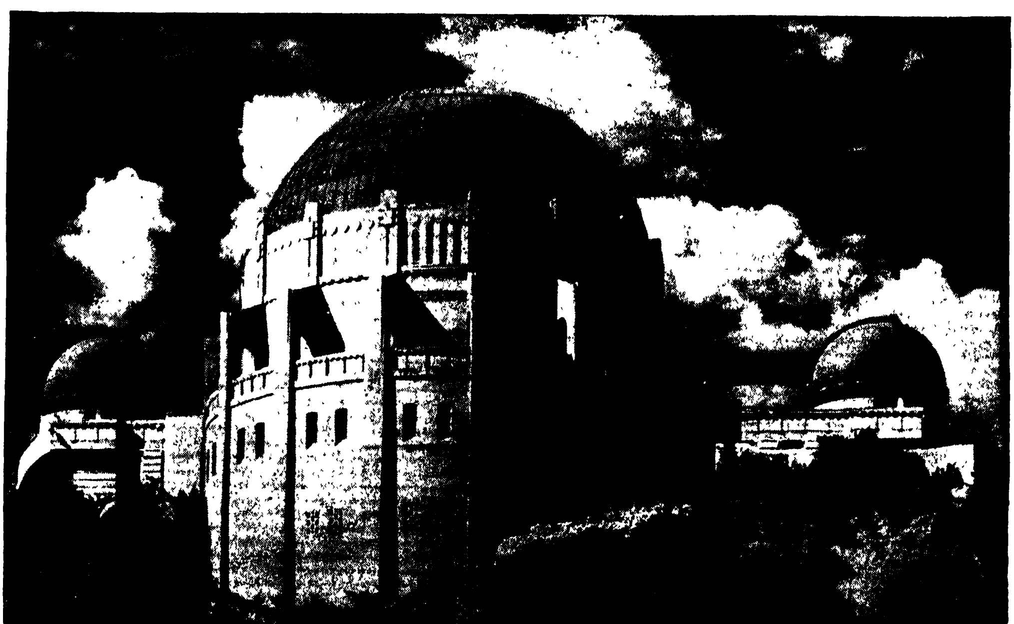
Sir William Herschel's type of telescope, the reflector, which uses a large mirror at the bottom end of the tube instead of a large lens at the front end, became very popular again toward the end of the nineteenth century. Today many large reflecting telescopes up to 100 inches in diameter are in use, most

of them in the United States. Several of them were made by John A. Brashear (1840-1920), his son-in-law and other successors at Pittsburgh; they also made fine lenses for refracting telescopes. The metal parts of many of these great modern telescopes of both kinds were made by the Warner and Swasey Company of Cleveland. Sir Howard Grubb, Parsons and Company, of England, have entered the field of great reflectors. They have built one instrument for the University of Toronto and another for Radcliffe Observatory in South Africa. Clustered around all these great telescopes are many astronomers and assistants, working on many problems concerning the stars; today the progress of astronomy is very rapid.

The success of the great 100-inch telescope at Mount Wilson, California, made it seem desirable to build an even larger one. George Ellery Hale (1868-1938), who had been the first director of the Yerkes Observatory and the designer and first director of Mount Wilson, set for his next goal a telescope 200 inches in diameter. After the Rockefeller Foundation had made a grant of $6,000,000 for the project, the Corning Glass Works of Corning, New York, set about to make the largest piece of glass ever ordered. The first attempt was unsuccessful but the second one was perfect and the 20-ton circular slab of glass was taken by special train to Pasadena, California, to be ground and polished to a perfect curve in the newly constructed optical shop of the California Institute of Technology, the institution selected to operate the telescope. The metal parts of the great instrument weigh almost 500 tons and were made by the Westinghouse Electric and Manufacturing Company, in Philadelphia; this mounting was erected in its dome on Mount Palomar in southern California in 1940, and thoroughly tested. The great mirror was not quite ready, however, and its completion was delayed until the end of the war. It is a telescope that can penetrate twice as deeply into space as the 100-inch telescope that has been so useful in extending our knowledge of the universe.

Now we must go back to Uranus, the planet whose discovery made William Herschel famous almost overnight. It refused to follow exactly the path laid out for it, and John Couch Adams (1819-92), a student at Cambridge University, thought it was because of the pull of another planet not yet known. When he graduated from the university, he had time to work on the problem. He worked out the answer to his own satisfaction and gave to the Astronomer Royal, Sir George Biddell Airy (1801-92), a calculation of where to look for this new planet.

In the meanwhile, the mathematical astronomer Urbain Jean Joseph Leverrier (1811-



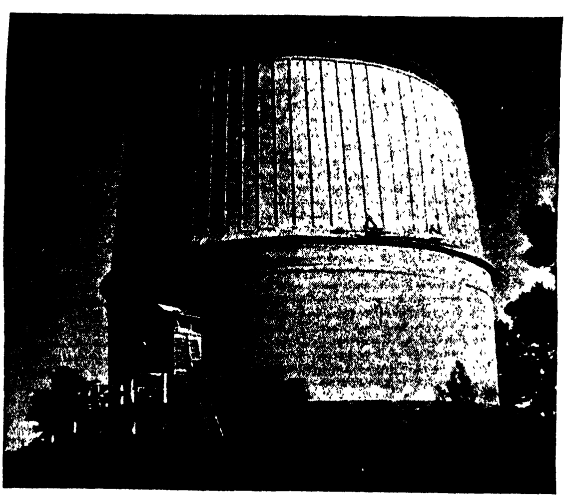
A planetarium reproduces the whole sky and its changes. The Griffith Observatory Planetarium in Los Angeles.

77), of Paris, had the same idea. He came to a satisfactory answer to the problem almost a year later than Adams, but he had the good fortune to send his results to the astronomer Galle, at Berlin. When the Astronomer Royal heard that the brilliant Frenchman Leverrier had predicted the position of a new planet, he remembered that a young Englishman had done the same thing, so he sent the results of Adams to Challis, the astronomer at Cambridge, who had a better telescope than any at Greenwich. He asked Challis to look for the planet in the place indicated by Adams, to verify the calculation.

Dr. Percival Lowell studied what looked like canals on Mars. Here he observes Venus in the daytime.

Challis did so and saw the object several times without being able to tell the difference between it and the stars. At Berlin, within half an hour of starting the search in the place indicated by Leverrier, the astronomer Galle found the planet on September 23, 1846. It was given the name of Neptune. The predictions of Adams and of Leverrier were equally good and both of them are now given credit for the discovery by mathematics of a new planet.

About two weeks later, William Lassell (1799-1890), of Liverpool, found the one known moon of Neptune. Lassell made many telescopes, including an especially fine one two feet in diameter, which he took with him to the rocky island of Malta in the Mediterranean Sea, to get away from the somewhat poor skies of England. Then he built an even greater telescope, four feet in diameter, the equal of Herschel's largest one. Armed with this powerful instrument, he pursued his researches further.



Dome of the refracting telescope at Lowell Observatory, Arizona.

In 1851, Lassell found two more moons of Uranus, thus bringing the total for that planet up to four. William Cranch Bond (1789-1859), of Harvard, and, a day or so later, Lassell, had found the eighth moon of Saturn in 1848. The ninth and latest known one was found by another Harvard astronomer, William H. Pickering, (1858-1938), in 1898.

Asaph Hall (1829-1907), at the United States Naval Observatory in Washington, discovered the two tiny moons of Mars in 1877. In 1892 Edward Emerson Barnard (1857-1923) discovered a fifth moon of Jupiter, closer to the planet than Galileo's four moons are. Barnard used the great telescope at the Lick Observatory of the University of California, where in 1904 Charles D. Perrine (1867-) found the sixth

and seventh moons of Jupiter. Then P. J. Melotte at Greenwich discovered number eight in 1908, and Seth B. Nicholson (1891-), at Lick, found number nine in 1914. Having in the meanwhile transferred to the Mount Wilson Observatory at Pasadena, Nicholson, in 1938, using the largest telescope in the world, discovered the exceedingly faint tenth and eleventh moons of Jupiter. They will no doubt be more clearly perceived when the new 200-inch telescope is set up.

Most modern astronomy is concerned with the stars and the nebulae and the structure of the universe. The tendency to neglect the planets became very evident along toward the end of the nineteenth century. A few interesting observations have been made by astronomers; for example, Giovanni Schiaparelli (1835-1910), of Italy, had noted some faint markings on the planet Mars. An American, Percival Lowell (1855-1916), was fortunate in having enough money to build a large private observatory in Arizona, where the sky is very clear. He became an astronomer and employed others to work with him in studying the planets. He was particularly interested in Mars; he drew many thousands of pictures of that planet as he saw it through his large telescope. The faint markings called canals he thought were due to intelligent beings on Mars who had dug a great irrigation system to make the best use of the slight amount of water that could be there. Today very few astronomers share the ideas of Lowell, for we know more about the planets. The Lowell Observatory continues to do fine work in photography of the planets and study of their changes.

Mount Wilson observers found no trace of either oxygen or water on Mars, yet the telescope is powerful enough to detect even a small fraction of the amount we have on the earth. At the same observatory and elsewhere it has been found that the atmospheres of Jupiter and Saturn consist of ammonia and methane, sometimes called marsh gas. These materials forbid the possibility of life on those planets as well as on Uranus and Neptune, whose atmospheres seem to consist of only methane. The planet Venus has an atmosphere of carbon dioxide, at least at the top; what lies below the dense clouds that always shroud that planet we do not know.

Both Percival Lowell and W. H. Pickering spent considerable time studying the motions of Uranus and Neptune; both concluded that there was another planet beyond Neptune. Each independently predicted where it would be found, and their results are very much alike. At last, after years of search, an assistant at the Lowell Observatory, Clyde W. Tombaugh (1906-), discovered the new planet by photography in 1930. It was named Pluto. Even in the largest telescopes it looks faint, and like a small star.

The study of the stars has progressed rapidly since about 1890. At the Harvard Observatory a great woman astronomer, Annie Jump Cannon (1863-1941), studied the spectra of hundreds of thousands of stars, putting them in groups and classes. Other women astronomers at Harvard patiently count hundreds of thousands of stars on photographs, or study the changes of brightness of the variable stars. Where the Herschels, father and son, discovered a few thousand nebulae, some of the young women at Harvard find scores of thousands on the photographs made with giant cameras. Under the guidance of Harlow Shapley (1885-), this work at Harvard is picturing the universe.

Acme photo

Annie Jump Cannon, famous woman astronomer, studied and classified many of the stars.

Sir Arthur Eddington studied what goes on inside the stars.

new way of thinking that includes many things—the law of gravitation, electrical and magnetic theories, even new kinds of geometry—and in some of his work the answers to some other riddles may be found by scientists of the present and future.

Many books about the universe have been written since 1925 for the general reader by astronomers. Among the many such books are those by Shapley, Hale, Sir James Jeans (1877-1946), Sir Arthur Eddington, Einstein and Edwin Hubble. At about the same time, the construction and use of the instrument called the planetarium began. America's first example was the Adler Planetarium in Chicago, opened to the public in 1930; in less than a year and a half a million people had attended the demonstrations, to see the stars realistically portrayed and to watch the sun, moon and planets move among the stars as we see them when we watch the actual sky. Other instruments like that in Chicago were installed in Philadelphia (1933), New York (1935) and Pittsburgh (1939), and daily demonstrations are given to thousands of visitors.

At the Mount Wilson Observatory, giant telescopes are able to penetrate deeper into space than at any other observatory. There the faintest star systems are examined and their distances and motions are studied. The work there and at Harvard has told us that, as Sir William Herschel concluded, we live in a flattened system of stars which we call our Galaxy or Milky Way. Outside our Galaxy are millions of Milky Ways, each one consisting of millions upon millions of stars. Edwin P. Hubble (1889-) and Milton Humason (1891-) have been particularly active in finding that these other galaxies all appear to be going away from us, as though the whole universe were swelling up.

In addition to this observational kind of astronomy, there are theories that deal with what is going on in the very hearts of the stars, where our telescopes can not probe. Sir Arthur Stanley Eddington (1882-1944), of Cambridge University, and Henry Norris Russell (1877-), of Princeton University, have been good at this kind of thing and there are many others. An American, H. A. Bethe (1906-), of Cornell University, in 1938 gave the answer to one of the greatest riddles of the universe; he told us how it is that the stars and the sun can shine for thousands of millions of years. They are not burning as gas ordinarily burns, but strange things go on among the atoms in the cores of the stars, and Bethe has explained how it happens.

One of the most interesting sets of thoughts is that brought forth by Albert Einstein (1879-), a German who has become an American citizen. He began with an entirely

Before Sir Isaac Newton, the work of most astronomers was devoted to the study of the moon and the planets; the stars were dismissed as fixed points of light. But for the past 250 years or so, the stars have been considered more and more important. Today very few astronomers study the planets and their moons; most astronomers study either the stars themselves or their numbers and arrangement and behavior.

Only a century ago there was no important astronomy being carried on in America. By 1890, much fine work was done on this continent. Today the huge telescopes we have and the great number of very accomplished astronomers connected with the observatories attract European scientists who come to visit and to study. Many of them stay. The generous and free interchange of ideas of astronomers of all nations will advance our knowledge of the universe and will improve the general level of civilization of mankind.

By Roy K. Marshall.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 3980.

A STORY OF FRANCE

VICTOR HUGO, one of the greatest of French writers, was born at Besançon in 1802. His father was a distinguished general in Napoleon's army. Hugo began to write poetry when he was not yet twenty. But he became famous, not only through his poetry, but through his plays and his novels. Les Misérables is his masterpiece. Because of it many authorities claim that he is the greatest writer since Shakespeare. This is the story of a soul purified by heroism and glorified through suffering. Valjean, the ex-convict hero, is one of the most splendid characters in fiction. Hugo died in 1885.

LES MISERABLES

EARLY in October, 1815, a tramp entered Digne, a little French town. It was near sunset. The man went into the Mayor's office, and then set out to find a place where he could spend the night. His appearance was against him, for his clothes were ragged, his beard was ragged, and his hair was uncombed. Added to these signs of poverty was a thick coating of dust from the highway. He went into the best inn that the town boasted, and asked for a meal and a bed for the night. The landlord looked at him sharply, and secretly sent a servant to the Mayor's office. The answer from the Mayor was sufficient to make him send the stranger away. When the tramp protested, the innkeeper said: "Your name is Jean Valjean. I know what you have been. Make yourself scarce!"

Valjean went out into the cold night and tried another and cheaper hotel. But there he met with a similar reception. In the whole town of Digne he could find no one to take him in. He tried to creep into a kennel, but the dog drove him out. Hungry, cold, and with very bitter feelings, he took to the road again. But finding no refuge, he returned to the town and sat down on some stone steps. A kindly passer-by advised him to knock at a house beside the bishop's palace.

He was admitted and was invited to supper and offered a bed. The stranger thought he was the guest of the parish priest, but in reality his host was the beloved Bishop of Digne, a man who spent his life doing good deeds and looking after the poor. Valjean was a rough-looking man of about forty-eight, and his appearance terrified the bishop's sister and servant; but the good old priest ignored their fear. The stranger at once said he was Jean Valjean, a released convict who had served nineteen years in the hulks. He had been freed four days and was walking from Toulon to Pontarlier. He had had to show his yellow passport to the Mayor, and as a result he had been refused shelter.

Early in the morning Valjean rose, stole the silver plate from the cupboard, and departed. He was brought back by the police, who said he had claimed that the priest had given him the silver. The good bishop bade the officers free the man. Then he handed Valjean two silver candlesticks, telling the ex-convict that he had forgotten them. Dazed and wondering, the man left the house.

More than two years later a Parisian girl, Fantine, started to walk from Paris to Montreuil. With her was her little girl. The father had deserted them, and Fantine was going to her

home to look for work. But passing through Montfermeil, Fantine was attracted by two little girls whose parents, the Thénardiers, kept an inn. She made an arrangement whereby Madame Thénardier agreed to keep her little girl Cosette, for whose support Fantine would pay a certain number of francs each month.

At Montreuil, Fantine secured work in the factory in which black glass jewelry was made. The owner of this factory was Father Madeleine. No one knew anything of Father Madeleine except that, coming to the town a stranger, he had saved two children of the police captain from a fire. That was two and a half years before Fantine arrived. Madeleine had brains, and he had built up his factory and brought prosperity to the whole district. Many men were jealous of the fortune he was making, but they could find nothing against him. Inspector Javert of the police, however, watched him carefully, for he felt that he had seen Madeleine on some other occasion.

Fantine was given a position in the factory, and sent money regularly to the Thénardiers. Little did she know that she was dealing with a pair of rogues and that her beloved Cosette was treated worse than a dog. At five years of age Fantine's child was made to do the work of a servant, and she was beaten and kicked without mercy. On every possible occasion the Thénardiers made more demands for money from poor Fantine. Finally she lost her position. She did not appeal to Father Madeleine, who had become Mayor, and she was penniless. To get money for her child she went from bad to worse, until at last she was arrested. Inspector Javert ordered her to jail for six months, but in the nick of time Father Madeleine appeared and freed the girl. Fantine, who was seriously ill, was sent to a hospital.

Just at this time an accident occurred near Montreuil. An old man named Fauchelevent was caught under a heavy cart which had been overturned. Father Madeleine saw the accident, and, through his enormous strength, although at the risk of his life, he lifted the cart single-handed and saved the old man's life. Javert saw the deed and recognized Father Madeleine as Jean Valjean. His strength had betrayed him.

Fantine, who was dying, pleaded to have her child with her, and Madeleine promised to have Cosette brought. But at that moment he heard that an innocent man was in danger of being sent to the hulks as the notorious Jean Valjean. He took part of his enormous fortune from the bank and buried it. Then he gave himself up to free the innocent man. Javert made the arrest, and Valjean was sent to jail for life. In the meantime Fantine died. Valjean was transferred to a ship as a convict sailor, but after making a heroic rescue of a shipmate, he disappeared in a raging sea; and the Government announced that he was dead.

But the Government was wrong. Valjean had escaped. He went at once to the spot in which he had hidden his fortune, and then started for Montfermeil. The name of the Thénardier inn was "The Sergeant of Waterloo." Thénardier pretended that he had been a sergeant in Napoleon's army and that at the battle of Waterloo had saved the life of a Colonel Pontmercy. The truth was that he was only a rogue who was stealing from the bodies of the dead. Colonel Pontmercy had recovered consciousness as Thénardier bent over to rob him, and had assumed that the man had saved his life.

Valjean reached the inn after meeting poor little Cosette, who was running away from the cruel treatment she had received. On payment of a large sum he took possession of the little girl. Thénardier immediately repented his bargain and raised an alarm that Cosette had been kidnaped. Javert heard this report and became suspicious that Valjean was not dead. The Inspector tracked the former convict and the little girl to Paris. Luckily Valjean saw his pursuer. His escape was very narrow. He scaled a high wall and found himself in a convent garden. The gardener proved to be old Fauchelevent who, out of gratitude, told the head of the convent that Valjean was his brother. For several years Cosette was a pupil in the convent, and Valjean was safe as a gardener.

In the meantime events were taking place at the little town of Vernon which were to have a profound influence on Valjean and Cosette. A youth, Marius Pontmercy, was living with his grandfather Gillenormand, a Royalist. Marius had never seen his father, Colonel Pontmercy, because his grandfather would not allow

it. But at the Colonel's death he learned all about his father's distinguished career, and became an ardent Republican. This led to a quarrel with his grandfather. Marius left for Paris to study law. At times he nearly starved, but he managed to pass his examinations. His father had left a letter in which he asked Marius to bear the title of Baron, which had been conferred by Napoleon, and to do his best to befriend a sergeant Thénardier, who had saved his life at Waterloo.

When Cosette had been a few years in the convent, Valjean decided that she must be taken away so that she would know life outside its walls. He took a house, and they lived very quietly. One of their diversions was walking or sitting in the Luxembourg Gardens. There Marius saw Cosette and, without knowing her name, fell in love with her.

At that period Marius was living in the Gorbeau House, a poverty-stricken lodging-house. A family called Jondrette also lived there, but they were very poor. Marius had helped them with money until he discovered that they lived on what they could get from sending out begging letters.

One of these letters was sent to Valjean, who lived under the name of Urbain Fabre. Valjean came to help the Jondrettes, but was recognized as Valjean by Jondrette, who was really Thénardier. Thénardier and his wife entered into a vile plot to rob, and even kill, Valjean. Marius, in the next room, overheard the plan and reported it to the police.

Valjean was decoyed to Gorbeau House and was set upon by Thénardier and his gang of ruffians. At a critical moment Inspector Javert appeared on the scene and arrested the ruffianly crew, but Valjean made his escape in the confusion. Marius had seen everything from a hole in the wall, and he was overwhelmed at the thought that it was this villain of a Thénardier to whom his father had owed his life. But Eponine, one of Thénardier's daughters, had an affection for Marius, and, unknown to her father, she found out Cosette's address for the young man. Cosette and Marius met and fell in love.

Thénardier escaped from prison, and would have robbed Valjean's house, but Eponine would not allow it. Her threats to call the police prevented the attempt. Valjean was making plans for going to England. When Cosette told Marius, the young man became almost mad.

The revolution of 1832 broke out, and Marius joined the Revolutionists. Barricades were thrown up in the streets, and behind them Marius was fighting. At his side was Gavroche, a *gamin*—that is, a street urchin of Paris. This little street arab was the son of Thénardier. Marius sent him with a letter to Cosette, and Gavroche gave it to Valjean. Valjean immediately went to the barricade to Marius. He found that Inspector Javert was held prisoner by the Revolutionists and was condemned to death. The ex-convict asked permission to be the executioner, but instead of killing his enemy, he let him escape. Gavroche was killed heroically. So, too, was Eponine, who was fighting in the garb of a man. The Revolutionists were overcome, and Marius was wounded. Valjean seized the young man and disappeared.

How he managed to do this, is told in the words of the book.

THE RESCUE OF MARIUS

IT was in the sewers that Valjean had descended.

A great city is like the ocean, the diver may go from sight beneath it.

The transition was incredible. In the heart itself of the metropolis, Valjean had stepped out of life, and in a twinkling, the time to lift a trap-door and slam it behind him, he had passed from broad day into utter obscurity, from midday to midnight, from turbulence to stillness, from the uproar of thunder to the stagnation of the mausoleum; and by a prodigious change beyond any he had met in an eventful career, from extreme peril to most perfect security.

It was a fall abruptly into a cave, a disappearance into the dungeons of the capital; the strange period of quitting the street, where death was everywhere, for this sepulcher sheltering his life. Safety had opened a panel to rescue him. Celestial bounty had taken him by treachery, in a measure. To think of Providence plotting an ambuscade!

The wounded man did not stir, and the bearer did not know whether he was carrying one living or dead.

His first sensation was blindness, for all at once he saw nothing. He also seemed deafened, hearing no sounds at all.

The frenzied, murderous storm unchained a few feet overhead sent no waves to him, thanks due to the space of earth between; nearly lost and indistinct, it came merely as a murmur in a depth. All he felt was that he had a firm foothold, and that sufficed him.

Stretching out one arm, and then the other, he touched two sides of a passage, and learned that it was narrow; he slipped, and was sure that it was wet. He thrust out a foot warily, dreading a hole, a fissure, or gulf, but the flagging was prolonged; a rank fetidness notified him where he was.

In a few instants he recovered his sight. A little light fell through the grating by which he had come, and he began to make out the objects. The tunnel in which he was earthed up, a word suiting the situation, was walled up in his rear. This was one of the drifts called, in the language of sanitary engineers, branches. Before him rose another wall—blackness itself. The gleam from the manhole died away ten or twelve feet from where Valjean stood, and made just a feeble mist on the damp borders of the drain for a few yards square. Beyond that the opaqueness was massy; it appeared horrible to have to plunge into it, and entrance was like ingulfing one's self. But still this wall of dense fog could be invaded.

Valjean had to make haste. As he had spied the sewer-grating, the soldiers might do the same, and all depended on this chance. They might likewise descend into the subterraneans, and search here. There was not a moment to lose. He had laid Marius on the ground, and picking him up and settling him on his shoulders, he marched onward. It was resolutely that he trod the darkened way.

In reality they were less safe than he imagined. Perhaps perils, no less dread, and of another kind, awaited him. After the fulgent cyclone of battle, the cavern of pit-holes and miasma—after chaos, the pestilence. Valjean had only fallen from one hell to a lower one.

When he had gone fifty steps he had to stop. A question arose. The corridor struck another closed-in gulley transversely. Which was he to take of the two ways—the right or the left? How find any way in this black labyrinth? It had but one clew—its trend; to follow its incline must bring one out at the river.

Valjean had divined this at the outset.

He reckoned that he was in the sewer of the Main Markets. Selecting the left run, and keeping to the slope, he ought, in a quarter of an hour, arrive at some outlet on the Seine, between two bridges; but this would be the appearance, in daylight, on the most crowded part of the town. Perhaps he would come up into some cross-road culvert. What stupor would be in the passengers to see two men, one bearing the other, emerging from the ground at their feet. Up would run the policemen and the guards from the next watch-house. He would be arrested immediately on coming forth. Better to turn deeper into this abode of plague and trust to its blackness—leave Providence to point out the safer issue.

He went up the incline, taking the turn to the right hand.

When he had gone round the corner, the faint light from the air-hole vanished, the curtain of gloom fell anew, and he was blind once more. Yet he advanced, and as rapidly as possible.

Both of Marius's arms were drawn round in front, so that, holding them in one hand, he was able to use his other to grope his way. Marius's feet dangled down behind him. His cheek touched his and stuck to it, for it was bleeding. He felt, streaming and soaking his clothes, a warm fluid from the wounded one; it was blood. But a warm feeling on his face, where Marius's mouth was near, indicated breathing, and, consequently, life.

This arched way was less narrow than the first, but the explorer moved painfully.

Recent rains had not wholly run off, and made a little torrent in the center of the gully, so that he was forced to hug the wall not to walk in the water. Thus he went on, befogged. He resembled some nocturnal creature groping in the Unseen World, and astray in the shady subterraneans.

Gradually, however, whether the light through ventilating shafts did lessen the murkiness to some degree, or his sight became accustomed to it, he had dim perception return to him, and could faintly get an idea of the walls beside him and the vault over his head. The pupil dilates in night and finally sees day, as

the soul dilates in misfortune and finds Heaven.

But to steer wisely was difficult.

In a measure, the lines of the drains agree with those of the streets. In Paris, at that time, were twenty-two hundred public ways. Imagine the tangle of branches which the sewers represented. Put end to end, they would have stretched over a line of twenty odd miles.

Valjean made a mistake at the start. He thought he was under St. Denis Street, and it was a pity he was not. Under that thoroughfare is an old stone sewer, dating from 164–, running straight to the main sewer, with only one turn and one branch. But the gut of Truanderie Street, with an outlet by Corinth Tavern, never communicated with this; it ended in the Montmartre Street sewer, and here Valjean was involved. Opportunities to get lost abounded. The Montmartre sewers are the most entangled of all the old system.

Happily, he had left behind him the maze by the Markets, but he had more than one embarrassing riddle, and more than one street-corner—for they are streets, in their kind—offering notes of interrogation.

If Valjean had had the plans in his head, he would have soon perceived, by merely touching the wall, that he was not in the ancient St. Denis Street sewer; instead of the noble old architecture, high and royal even here, in costly cut stone base and the best mortar, he would have found the modern economical expedient, cement and rubble filling; but he did not know anything on this head.

He went straight ahead, with anxiety, and yet steadily, seeing and knowing nothing, buried in chances—or, rather, ingulfed in Providence.

Some feeling of horror by degrees stole over him. The shades in which he blundered sunk into him. He strode in an enigma. This aqueduct of mud is dreadful; the criss-crossing is dizzying. It was lugubrious to be caught in this city of dreadful night. Valjean was obliged to find—almost to invent—his route without seeing the region. Every step in such a blank might be destruction.

How could he get clear of it? Where meet an outlet? Would he meet it in time? Would this colossal granite sponge let him bore and pierce through it? Would he not be strangled in some inextricable knot of duskiness? Would he not arrive at a chasm not to be crossed or fathomed? Might not Marius die of loss of blood or of hunger? Would not the end be that both would perish and become two skeletons in some corner of the foul den? He was unaware. He asked without finding an answer. The bowels of Paris were a precipice. Like the Prophet Jonah, he was in the intestines of Leviathan.

Suddenly he encountered a surprise.

At the most unexpected period, though he had not ceased to move straightforward, he discovered that he was no longer tending upward; the water in the gutter slapped against his heels, instead of washing his toes. Therefore, the sewer was on the decline. How was this? Was he going suddenly to come out upon the river? This was a great danger, but to recede was a greater one. He pressed on.

He was not going toward the Seine. The water-shed of Paris at this part on the right bank throws the wet down one steep into the river, but off the other into the main sewer. He was at the ridge summit, and took the outer drain, which was right, though he did not know it.

Every time he came to a fork, he felt the angles, and if he found the fresh opening wider than that he was traveling, he chose it, reasoning that the narrower ones were secondary, and would end in no way out and only divert him from his aim, the principal issue. Thus he avoided the plot of the Dædalus.

At a certain time he guessed that he was leaving the part of the city where traffic was suspended by the barricades, and petrified, and entering under Paris lively and normal, for suddenly rumbled overhead the far but continuous roll of thunder. It was the turning of wheels.

He had been walking for upward of half an hour, as he computed, without any thought of resting; but he had shifted the hand which held Marius's. The darkness was thick as ever, but it cheered him.

All at once he saw his shadow before him. It was defined in a dim, reddish glimmer, vaguely impurpling the paving at his feet and the arch above, and gliding on both sides along the slimy walls of the passage. Stupefied, he turned round.

Behind him, in the part of the tunnel which he had passed through, at a dis-

tance which seemed immense, a sort of dread star flashed across the gloom, as if watching him.

It was the eye of the Police rising in the drains. Behind its rays confusedly moved eight or ten black, upright, indistinct but alarming forms.

The explanation is easy for us. On the 6th of June, a hunt in the sewers was ordered. It was feared that the vanquished would take to them for escape, and Prefect Gisquet was to sweep occult Paris as Marshal Bugeaud was the upper town. Three platoons of police and sewer-men explored the subterranean ways, both river-banks, and the Old City islands. The police were armed with rifles, life-preservers, swords, and daggers.

The right bank squad had their lantern now directed to the part where Valjean was fleeing. It had investigated the parts under Cadran Street. While searching there with the light, Valjean had passed a curved gallery, where he would have been caught. But on themselves coming out of it, the policemen thought they heard steps, and they were the fugitives', indeed. The sergeant lifted his lantern on high, and all stared in the fog whence had come the sound.

It was a moment of inexpressible tribulation for the man.

Luckily, though he saw the bull's-eye well, it did not see him; it was light, but he the shadow. He was afar, and mingled with the mist. He stood up against the wall and waited. He did not clearly understand what it was about. Want of sleep and food, the smells, emotions, all had lifted him into the visionary state. He saw the flare and black creatures around it, but he did not comprehend what they were.

On his stopping, all sound ceased. The watch listened, and heard nothing more; they looked with the same non-result. They consulted. The man at bay saw them gather, and they whispered. They concluded that they had been mistaken, that there was no person, and consequently no noise, and that it was useless to march into this trench. Instead of so losing time, they had better hasten toward St. Merry's, where there would be work and some rebel to track, if any, in that district.

The sergeant ordered his platoon to take the left toward the incline to the Seine. If he had broken them into two squads, and sent them both ways in the outer belt, Valjean would be taken. This hung by a thread. It is likely that the headquarters' instructions, from foreseeing a meeting with the fugitive rebels in force, commanded no scattering of the police. The rounds went on the march, leaving the missed one behind. Valjean perceived nothing of this movement, save the eclipse of the lantern which suddenly turned.

Before going, the sergeant, to relieve his conscience, fired off his rifle in the direction of Valjean. The report echoed over and over again under the crypt, and a bit of mortar falling with a splash into the water warned Valjean that the bullet had struck the vault above him.

Slow and measured paces resounded for awhile on the pave, deadened more and more by distance, the group of dark forms faded as the light waved and floated, reddening the arched roof, but all disappeared. The silence recovered rule over the shadows, and Valjean, not daring yet to move, stayed a long while leaning against the wall, with ears stretched and eyes dilated, watching the vanishing of this phantom patrol.

It is only fair to state that the police coolly fulfilled their duties of keeping the ways clear in these grave public disturbances. A riot was no excuse, in their eyes, for letting the malefactors take the bit in their teeth, and for society to be neglected because the ruling powers were in peril. The ordinary service went on together with the extra, and was not ruffled.

In the midst of an incalculable political event in progress, under the pressure of possible revolution, without allowing insurrection and its barricades to hinder him, a detective was "shadowing" a suspicious character.

This was occurring on the Seine right bank, a little this side of the Invalides Bridge. The two men were watching each other, and one avoiding his pursuer. The leader tried to increase the distance between, the other to approach. It was like a quiet game of "tag." Neither wanted to hurry on matters, and both moved slowly, as though fearing that too much haste would spoil his chances. It was a wild creature following its prey without seeming to have run it down expressly. The prey was on its guard, and went warily.

The proper interval between the weasel dogged and the canine trailer was observed. The fugitive had little substance and a sickly look; the would-be captor was a tall man of rough appearance, whose charge would be overpowering. Feeling himself the weaker, the first avoided any encounter; but he did so with an enraged manner; in his eyes were all the somber hostility of enforced flight and the menace in fear driven to bay.

The strand was lonely, with not only no passenger, but neither boatman nor longshoreman from the barges moored hard by.

From the quay the pair could be viewed, and for those examining them from that distance the runaway would appear a tatterdemalion, hairy and sneaking, restless and shivering under a ragged blouse; the other was an old-school police officer, wearing the official long-skirted coat buttoned up to the chin.

What was the latter's aim? Probably to overtake the leader and provide him with warmer clothes.

When a police officer dogs a man in rags, it is to put him in the state livery. But the color comes into play. Clothe the capture in military uniform, and he becomes glorious; in convict suit, and he is disagreeable. This one was doomed to wear the felon's garb.

This is what he was endeavoring to elude.

If he let him run free without overhauling him, it was because he hoped to drive him into some haven for his kindred cruisers, or at a meeting with some dangerous criminals. This timing of a capture is called "shadowing," as formerly it was "dogging."

What made the supposition more likely was that the pursuer, catching sight of an empty cab on the embankment, made a sign to the driver. He understood, evidently recognized what sort of fare he was engaged for, wheeled round, and followed the couple. This was not noticed by the ragged rascal, who was on a lower level. The hack rolled along under the Champs Elysées trees with only the hack-driver's bust and the upheld whip seen over the parapet.

One of the secret instructions to the police contains this article:

"Always have a hackney-carriage at hand in case of an arrest."

While each was maneuvering with irreproachable strategy, the two men neared a sloping ledge which allowed the hackmen to drive down to the water's edge and water their horses; this has been done away with, as it spoiled the symmetry of the embankment, but if the eye is gratified, the horses suffer with thirst.

It was likely that the hunted man was going to try by this rise to escape among the trees of the pleasure-ground, though it would be sprinkled with police who would lend their brother-officer a willing hand. This point is not far from the "Francis I House," and a soldiers' guard-house stands close.

To his watcher's high astonishment, the chased man did not go up the incline of the watering-place, but kept right along the river-edge. His position became critical.

Unless he meant to walk into the river, what did he mean to do?

There was no further means to get upon the bank, no slope, and no steps; and they were near the mark where the river, by an elbow at Jena Bridge, was entered by the strand finishing with a slender tongue. Here the fugitive would inevitably be blocked between the straight up and down wall on his right, the water in front and left, and the policeman in the rear.

The actual end of the walk was hidden by a heap of rubbish some seven or eight feet high, dumped there after some house pulling down. But the man could never think of hiding himself there after simply turning it. The expedient would be puerile. Certainly he would not think of it. The simplicity of the thieving class does not go to that degree.

The pursued one reached and doubled this petty cape, so that he was lost to the other's sight. Not seeing, he judged, ostrich-like, that he was no longer seen; he snatched at the advantage by throwing off all dissimulation and stepped out rapidly. In a few instants he was at the rubbish pile, and went round it, where he stopped, stupor-stricken; the hunted man had disappeared.

The strand only ran thirty paces further, where it dived under the water, plashing the quay wall. The fugitive could not have climbed here or swum the stream without being seen.

What had become of him?

The man in the buttoned-up coat

strode to the end of the shore, where he stood thoughtful for awhile, with his eyes searching and his hands clinched convulsively. Suddenly he beat his brow. He had descried, where the land ended and the water begun, a broad, low iron grating under an arched way, garnished with a heavy lock, and on three enormous hinges. This opened on the water as well as on the foreshore. An inky flow rolled out of this orifice, and proved it was meant to disgorge into the river. Inside the rusted and clumsy bars a dark arched passage could be discerned.

The man folded his arms and looked at the grate with a reproachful manner. The look not satisfying him, he tried to push it, but it resisted solidly as well as his shaking. It was probable that it had been opened, although he had heard no noise, singular in so rusty a gate. But it was certain that it was fastened up now. This betrayed that the man who had gone through had a key rather than a "lock-pick." This belief burst upon his mind so forcibly that he tried to shake the grate open, which drew from him this indignant exclamation:

"This is going too far! The sneaks are carrying the Government's own keys now!"

But speedily calming down, he expressed his throng of ideas by syllables accented almost ironically:

"Whew! this is where the Break-o'-day Boys dwell when they say, 'Under *Pantin* (Paris)!'"

This spoken, hoping one knows not what, either to see that man come forth or others arrive to join him, he posted himself concealed behind the heap of trash, with the fretful patience of a dog in the leash.

On his side, the hack-driver, who had regulated his movements by the detective's, halted on the upper roadway; foreseeing a long spell of waiting, he hung a moist bag of fodder to his horses' heads respectively. The scarce passengers on the bridge, before going away, turned their heads briefly to regard the two features of the still-life scene, the watcher on the strand and the driver by the parapet.

During this incident, Valjean had resumed his walk without stopping any more.

It became more and more laborious. The level of the gullies varied; the medium height is five feet six, calculated for the average man, so that Valjean was forced to stoop not to knock Marius's head against the key-stones. At every instant he had to bend, rise, and feel the wall. The moisture on the sides and the viscousness on the floor gave bad rest for hand and foot. He stumbled over this dung-heap of the great city.

The intermittent glimmer of the ventilator holes appeared but at very long spaces, and so dull that the brightest sunbeam was but like the moon's ray; all the rest was dark, fog, miasma, opacity. Valjean felt hunger and thirst, the latter particularly; it was as bad as being on the sea, for there was "water, water, everywhere, but not a drop to drink." His prodigious strength began to flag, though little lessened by age, thanks to his chaste and sober life. Fatigue burdened him, and his failing powers increased the weight of his load. Marius, perhaps dead, weighed like a lifeless body.

Valjean sustained him in such a way that his chest was not squeezed in and his respiration went on regularly.

Between his legs he felt the rats scamper; one was so frightened that he bit him in passing.

From time to time, through air-holes, a whiff of pure wind came to revive him.

It might be three o'clock in the afternoon that he arrived at the main drain.

He was amazed by the sudden enlargement. He was unexpectedly in a hall where his hands could not touch the walls and his head went nowhere near the roof. The grand sewer is eight by seven feet.

Here was a cross-road where a wiser man would be puzzled. Valjean went for the largest, the circuit drain. But the question arose: to go up or down? He thought that the circumstances were pressing now, and that he must reach the river, that is to say, go down the general incline.

He turned to the left.

This was good again.

If he had gone the other way, he must have met a wall and would be lost, exhausted after a thousand exertions in the gloom. There was, indeed, another way, which would have brought him out *via* the Bastille, on the Seine, near the Arsenal; but he never could have got through such ramifications; it would have required profound knowledge.

He knew nothing at all about this underground and frightful medley of passages, and if he had been asked where he was, he must have replied:

"In night!"

His instinct served him to the point; to follow the slope was possible safety.

At the crossing of the branch from the Madeleine Church Ward he came to a halt from weariness. A rather large air-hole, probably Anjou Street, gave quite a vivid light. With gentleness befitting a brother handling another wounded, he set Marius on the ledge of the drain-side. The bleeding countenance appeared in that glare as if in a grave. His eyes were closed, his hair glued to his temples, like paint-brushes dipped in varnish and dried, his dead hands dangled, his limbs were cold, and blood had coagulated at the corners of the mouth. A clot of gore filled up the knot of his neck-cloth, the shirt was sucked into the gashes, and the coat chafed the raw lips of the wounds.

With his finger-tips thrusting back the garments, Valjean laid his hand on his bosom, where the heart still throbbed.

Valjean tore his shirt, stanched the blood as well as he could, and bound up the wounds; then, bending over the scarce breathing and wholly unconscious man, he regarded him with inexpressible hate.

In disarranging his clothes he had found two objects in his pockets—a small loaf of bread, bought by Marius in hurrying to the barricade, and his note-book. He opened the latter while eating the bread. On the first leaf he found these lines, written by the young man:

"My name is Marius Pontmercy. Carry my remains to my grandfather's, Monsieur Gillenormand, No. 6 Filles-du-Calvaire Street, in the Swamp."

Valjean read, and stood for a second self-absorbed, repeating the directions. He replaced the book in Marius's pocket, and as strength returned to him from having eaten, he took him up, as before, on his back, carefully settled his head down on the hollow over his left shoulder, and resumed the descent of the drain.

The main drain, following the Menilmontant water-shed, is nearly four miles long; it is pretty well all paved.

Nothing enlightened the wanderer on the parts of Paris he traversed, or on what he accomplished. But the growing pallor of the gleams through the ventilator shafts, met now and again, told him that the day was waning, and the rolling of vehicles, from continuous, had become broken, and finally ceased. He concluded that he was no longer under busy Paris at its core.

Where there are less streets, the sewers have less openings, so that the gloom deepened around him. But he continued to progress, though he had to grope his way.

This shade became suddenly terrible.

The refugee felt that he was wading, and that, instead of being muddy water, it was mud.

He was confronting a sink-hole. The old style of sewers was subject to crevasses and sinking spots. The water soaked in where the surrounding ground was very sandy; the paving, of small stones, gave way where undermined. The bottom, for a distance, sunk, but the floor remained, floated on the fluid, and submerged in the sand. It is the quick-sand of the sea-shore suddenly met on dry land. The saturated soil is in fusion, the molecules are held in suspension in a shifting medium, neither earth nor water. The depth is sometimes so great that to walk into one is most disastrous. If the water dominates, death comes promptly—it is swallowing up; if the earth is the stronger element, the death is slower, and it is stifling.

Imagine such a death! If such a drawing down into the depth is awful on the sea strand, what must it be in a sewer? Instead of the full air and light, the clear horizon, the vast surge, the free clouds from which rain life itself—the hopes under every form, probable way-farers, boats landing, possible rescue up to the latest time, it is blindness and bewilderment, a black roof as of a tomb already begun, death in a witches' caldron with the lid on; suffocation in a pool, a stone box, where asphyxia opens its claw in the mire and clutches you by the throat; fetidity mingles with the death-rattle; mud instead of sand, sulphureted hydrogen instead of tempest, ordure instead of ocean! Here he can call, gnash teeth, writhe, and go down in agony with that immense city overhead knowing nothing!

The inexpressible horror of such a fate!

Sometimes death redeems its atrocity by a dread dignity. On the funeral pyre of shipwreck it may be grand; in flame

or foam a proud attitude is possible; one is transfigured. But not so here. Death is uncleanly; it is humiliating to expire. Filth is synonymous with shame; it is paltry, ugly, and loathsome. To die in a butt of malmsey, like Clarence, may pass; but in the ditch, like Jane Shore, is horrible. It is hideous to battle in it; it is floundering while dying. It is shady enough to be hell, but so nasty as to be a swinish wallow, and the dying one can not tell whether he will be a ghost or a toad.

Elsewhere the sepulcher is sinister, but here it is nameless.

The depth of these sinks varies, as well as the widths and degree of turbidity, according to the density of the soil. One may be three or four feet, or eight or ten, or again bottomless. Here the mess is almost solid, there nearly liquid. In one a man goes under in a day, in the next it takes but minutes. A child might walk over where a man would sink. The first rule for safety is to lighten one's self as much as possible. The scavenger tosses away his scoop-shovel, lamp, or wading-boots when he feels his footing melt away from under him.

This species of defect was frequent about the Champs Elysées, hard to treat with hydraulic works and tender under buildings subterraneous on account of excessive inconstancy. When the part was rebuilt, in 1836, where Valjean was now inmeshed, the quicksand gave the men six months' work.

The previous day's rain had caused this subsidence. The water had filtered under the flooring and dislocated it so that it settled down. It was impossible to say how far, as the darkness was thicker here than elsewhere. It was a pit of mud in a cavern by night.

Jean Valjean felt the flooring fail him, and he was walking in mire. Over the silt was water, but he had to cross somehow. To retrace his steps was out of the question. He was tired, and Marius expiring. Where else had he to go?

He dashed on. Besides, the depression did not seem bad at the start; but, as he proceeded, the mud deepened. He was soon up to mid-leg in it, and in water to the knees. Still he waded, holding up his burden as high as he could out of the water. The mud came up to his hams now, and the water to the girdle. He could not retire, and yet was sinking more and more. The hodge-podge which might have buoyed up one man could not uphold two.

Either of them might struggle through alone, but Valjean continued, though, perhaps, he was carrying no better than a dead man.

The water laved his armpits, and he felt still sinking; he could hardly move, on account of the clogging of the stuff he forged slowly through. The density which was sustenance to him was also the hindrance. Still he held up Marius, and gained a little, though at a tremendous outlay of vitality; but he sunk and sunk. Only his head was above water, and his arms upholding Marius. In the old paintings of the deluge you may remember the mother holding up her child in this same way.

Still going down, he had to lean his head back to keep the sludge out of his mouth and get a breath. Seen in this gloom, he would have presented but a mask floating on the surface to the eye. He himself dimly saw Marius held over him with livid face. He made a desperate effort with a thrust of the foot forward, met something solid, and had a foothold.

It was time.

He rose and stiffened himself, taking root with a kind of madness. This limit had the effect of the first step of the stairs leading up into life.

This firm mass met in the mud in the critical instant was the other side of the bottom, sagged down without parting into pieces, as a net might do. Well built pavements will form an inverted arch and hold together thus. This portion of the floor was a ladder on which one was saved.

Valjean had but to climb up it, and find himself on the further side of the sink-hole.

On leaving the water he stumbled over a stone, and was thrown on his knees. He thought this a warning, and stayed there for a spell, with his spirit departed in a prayer of thanksgiving.

He arose, shivering with cold, infected, bent under the corpse he was ever bearing, streaming with filth, but his soul clarified with a strange luster.

Once more he took up the road.

Though he had not left his life in the quicksand, his strength seemed there. That mighty effort had exhausted him.

Such was his lassitude that he was obliged to stop and lean against the wall every few steps and recover his breath. Once, having sat on the ledge to shift Marius's position on him, he feared that he could never rise again. But if his vigor was dead, not so his spirit. He did rise.

He trudged on desperately, almost swiftly, for a hundred strides, without raising his head, and scarcely breathing, till he suddenly knocked his head against a wall. Lifting his eyes, he saw a light low down and afar at the end of the underground passage. This time it was not artificial and threatening light, but the good, white light of day.

Valjean saw the outlet.

What he felt would be experienced by a damned soul amid the furnace, who suddenly had disclosed to him the gates of Gehenna. Toward that radiant doorway it would fly with its stumps of scorched wings. Valjean no longer felt fatigue or the weight of Marius, and he recovered the steel muscles of his legs. He ran rather than walked.

As he drew nigh, the issue became more and more defined. It was a flat arch, not so high as the vaulted way leading thither, and less wide than the gallery which narrowed as it neared it. The tunnel finished like a funnel, a vicious shrinking, logical in a prison-hall, but unreasonable in a gully, and since corrected.

Arriving there, he came to a halt, for it was an exit through which he could not depart.

The archway was filled up with a strong grated door, not often turned apparently on its oxidized hinges; it was fastened to its stone sockets by a thick, heavy lock, which seemed an enormous brick from its rusted color. The keyhole could be seen, as well as the massive bolt which it moved, deeply shot into its socket of iron. This had been pushed forward two nicks, it was plain—that is, double-locked. It was one of those old-fashioned locks relying on bulk with which old times abounded.

Outside this barrier was the open air, the river, day, the narrow strand, but enough to walk upon—Paris! that gulf where a hunted man so easily can hide, the broad horizon—freedom! On the right was Jena Bridge, on the left the Invalides Bridge, a spot propitious for waiting for night and making off. This shore facing Gros-Caillou was one of the loneliest places in the town. Flies were buzzing in and out through these bars.

Day was declining; it was about half past eight.

Valjean laid Marius alongside the wall in the dry part of the gutter-way, marched up to the grating, and grasped the bars with both hands; the shock was maniacal, but not a quiver responded. The grating did not budge. Valjean tried the bars one after another, hoping to be able to wrench out one and use it for a lever to break the rest or prize off the lock. Not one moved. A tiger's teeth are not set firmer in their sockets. There was no lever here, and no forcing was possible.

The barrier was invincible; he had no means to open that door.

Was he doomed to finish here? What was he to do? What would befall him? Was he to retrace his steps, recommence the dreadful journey already barely struggled through? He had not the strength. Besides, how could he again cross that quicksand from which nothing but a miracle had extricated him? After that, what about that company of police who would be continuing their search? Were they to be twice eluded?

And then, how go? What direction should he take? To follow the incline was not to arrive at any goal. Would he arrive at an opening, or a dead wall, or an outlet sealed up like this? All the issues might be fastened up thus. Chance had left open the man-trap by which he had entered, but the others had been looked to, evidently.

He had succeeded in escaping—into a prison.

All was over. His toil had been useless. Exhaustion had eventuated in failure.

Young man and old were taken in the somber, immense toils of death, and Valjean felt that the horrid spider was running over the vibrating threads in the dark.

He turned his back to the grate, and fell rather than sat on the ground near Marius, ever unmoving, and his head sunk on his knees.

No way out! It was the last drop of woe.

Of whom did he think in his profound depression? Not of himself or of Marius,

but of the young woman whom both loved—of Cosette.

In the midst of this disheartenment, a hand was laid on his shoulder, and a voice spoke low:

"Halves!"

Somebody in this darkness? Nothing is so like despair as dreaminess, and Valjean might believe he was dreaming. He had not heard any steps. Was it possible? He raised his eyes.

A man stood before him.

He was clad in a smock; his feet were naked; he carried his shoes in one hand, evidently having taken them off, that he might creep up to the stranger without being heard.

Valjean had not a moment's hesitation. Unforeseen as was such a meeting, he recognized this man as Thénardier.

They had met under peculiar circumstances every time. The first was when Valjean, fleeing from justice, came to Thénardier's inn at Montfermeil to take away the child, Cosette, of an unfortunate woman, named Fantine. She had left her little daughter in the keeping of the Thénardiers, who had extorted more and more money from her, on various pretexts, so as to drive her into a life of shame to acquit herself of the debts. Valjean had paid all demands and removed the ill-treated child.

After eight years, he and Cosette, a grown girl, in their rounds of alms-giving, had been decoyed by a begging letter into Thénardier's garret in Paris. Here the ingrates, after benefiting by their kindness, had entrapped Valjean into returning alone; their project was to make him sign a check for a large sum, while they held his suppositious daughter as hostage. Luckily, the captive had only pretended to agree to their designs to gain time to sever his bonds. Released by his own hands, he had shown that they could not daunt him, but when, with Christian resignation, he let them wreak their worst, the police rushed in, led by Inspector Javert, and foiled the villains. In the scuffle Valjean disappeared.

Thénardier had been sent to prison, but he had escaped.

Although startled by his appearance here, Valjean was so inured to surprises and alarms that he instantly recovered his presence of mind. Besides, the state of affairs could not be made worse; a certain degree of distress can not rise on the crescendo, and even a Thénardier can not add to the blackness of such a night.

There was an instant of expectancy.

. . . .

We must leave Hugo's words to tell the rest of the story briefly.

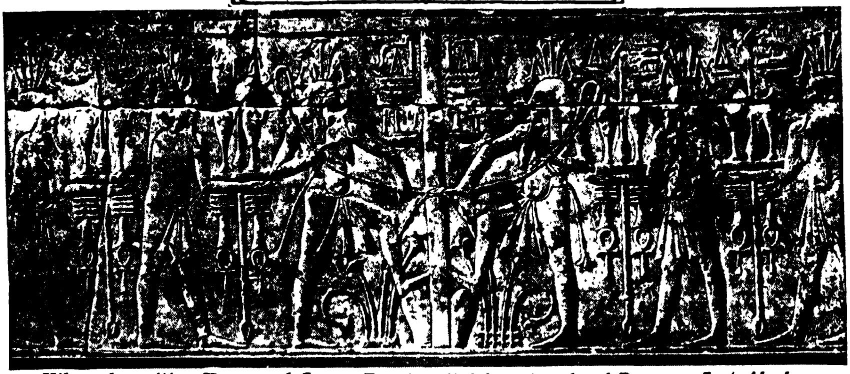
With relief Valjean saw that Thénardier did not recognize him. The pretended sergeant of Waterloo offered to let Valjean out of the sewer for half of what he had received from his victim, as he supposed Valjean had murdered Marius. Valjean gave him all he had in his pocket and was let out. But he ran into the arms of Inspector Javert. Javert, who was very silent, accompanied him to the home of the Gillenormands, where Marius was left with his grandfather. Valjean asked then to be permitted to call at his home. Javert agreed and waited downstairs. But when Valjean came down, the Inspector had disappeared. The hard-hearted police inspector had failed in his duty because Valjean had saved his life at the barricade. But because he felt his failure he drowned himself in the Seine.

Gillenormand had forgiven his grandson and consented to the marriage with Cosette. Valjean immediately settled the whole of his fortune on the pair. After the wedding he told Marius the truth about himself. He as a young man had stolen a loaf of bread to feed his sister's family. For that he had been thrown into prison. When he was freed, the action of the Bishop of Digne had made him want a better life.

Marius was dismayed and angry. He did not want Cosette to have anything more to do with Valjean, but he relented to the extent of allowing his wife to see the old man once a day. Gradually that dropped off. One day Thénardier appeared and threatened to expose Valjean. He told Marius that Valjean had committed a murder, and in proof he produced a piece of cloth torn from the supposed victim's coat. Marius recognized the material as that from his own coat, and he knew then—what he had never been able to discover—that Valjean had rescued him from the barricade.

With his heart full of grief at his own conduct he took Cosette at once to Valjean's lodging. He was just in time, for the old man was dying. But it was with joy that Valjean gave them his blessing.

THE NEXT STORY OF FAMOUS BOOKS IS ON PAGE 4069.



Nile gods uniting Upper and Lower Egypt; relief from temple of Rameses I at Abydos.

THE FIRST SCULPTORS

ONCE, when the world was young and strange, a world of unfamiliar lands and seas, there lived a man who was more watchful of Nature's ways than his fellow-men were. One day he discovered a kind of clay that would bake in the sun's heat, and he made a rough bowl, shaping the clay with his hands. His fellow-men may have considered him great beyond compare; they may have killed him for daring to apply natural forces and to make something new.

Be that as it may, in the process of time other baked pots were made; and there came a day when one man had an impulse to make some marks on his bowl—a pattern. That was probably some seven or eight thousand years before Christ. In that first rough bowl, patterned with marks made by the potter's thumb, we can read the first chapter of one of Time's fairy tales that tell of the wonder of imagination and development. We may ask how the matchless vases of the Greek potters could ever have been formed had not that earliest of all potters, perhaps a bit afraid at his own daring, made the first clay pot.

The sense of shape and line, the instinct for what we call art, was not developed as an æsthetic gift; it grew out of usefulness. To be of any use at all a bowl must needs be of a certain shape and proportion. Its decoration was an afterthought; but slowly and unconsciously, as centuries went by, the sense of the beautiful developed. In a general way, the forms that were kept were those most free from unnecessary curves; and the ornamentation of pottery went through the same processes, working toward simplicity.

The earliest ornaments on the earliest bowls and stone pillars were Nature's ornaments, in spirit if not in shape. They were lines, curves, and forms which potters had learned by studying either the sea with its repeating wave lines, or the forest trunks and leaf masses, or the subtle repetition of curve in mountain ranges. From the day of the earliest potter to the present, such forms—man's puny and mechanical attempt to reproduce Nature's majestic lines—have been the basis of ornament. A student in an art school to-day struggling to work out a "repeat" for a wall-paper or floor-covering design, is not so far as one might suppose from the untutored savage making groups of rhythmical marks on his clay dish, in spite of the several thousand years that lie between, with their accumulation of civilization's habits and

problems. The old mysterious beat and throb of natural life, with line after line strangely alike, yet differing one from another, is the beginning of rhythm. This is the force which stirs in the consciousness of poets and musicians.

EARLY SCULPTURES THAT EXPRESSED THE THOUGHTS OF THE ARTISTS

This decoration by ornament which does not use the forms of men and animals was the second chapter of the wonderful story of design. Of the first we know something already; it told us about the cave-men of Europe and their marvelous drawings on rock, bone and ivory—drawings executed thousands of years before the first potter made his first bowl.

The earliest history which tells us of art, history gathered from records and inscriptions, is that of Egypt, Babylonia and Assyria. It begins more than four thousand years before Christ. At first—for centuries, that is to say—Egyptian art was the laborious expression of the instinct and religion of the race; the sculptors were "thinking aloud," and were not conscious of their work as art. Only in later times did this expression of themselves become an art, when they gave special thought and skill to this kind of work as a craft. Their early statuary, then, was an attempt to give shape to their imaginations. Besides, they thought that they could gain favor and protection from the gods, whom they considered the rulers of the world, by creating magnificent forms to represent them. Thus we see that the sculpture of ancient Egypt was concerned with something that only a strong imagination helps us to understand. Starting with the consciousness of life, the certainty and mystery of death, and the fear of the unknown, they built up out of these a definite religion which was to govern their lives and help them to face death with calmness and courage.

THE LIFE OF OTHER DAYS PRESERVED IN THE TOMBS OF EGYPT

Next in importance after the gods came the kings. The bulk of the statuary which the marvelous climate of Egypt has preserved for us represents the imaginary life of the gods and the glorified doings of rulers. The representations of both deities and heroes centred, for the Egyptians, in temples and tombs stately in their massiveness.

No relics of domestic art in any other country can equal the magnificence of sculpture, pottery and jewels found in the tombs of Egyptian kings and queens. And we do not yet know how many treasures may lie buried from our view. The discovery of Tutankhamen's tomb late in the year 1922 amazed the world by the splendors revealed—stores of objects showing skill in modeling and color.

The labor in the tombs was done for the most part by unknown sculptors and craftsmen who had no idea they were working upon something which six thousand years later would be described as Egyptian art; they were merely doing what they had been commanded to do, and its purpose was duty to the dead.

From this scheme of thought were brought forth the magnificent statues of the gods and kings of Egypt which stand apart, in their largeness of spirit and grandeur of symbolism, in the art of the world. If we had only two words to describe Egyptian statuary, we should say that it was huge and it was calm; it expressed that central idea of "enduringness" round which, like a husk round a kernel, the creed of the race was wrapped.

HOW WE CAN TRACE THE PROGRESS OF EGYPTIAN ART

And so we get statues like those colossal figures of kings, rulers and gods which make the most casual and ignorant visitor to our great museums stand in amazement, and feel that, after all, his or her understanding of life and destiny is very narrow and changing. In the Egyptian rooms of the Metropolitan Museum objects belonging to widely separated periods are brought together; but imagination helps us to see them as they stood in the vastness of great temples, in sealed tomb-chambers or out upon the "lone and level sand."

At first thought it would seem that this statuary had not changed at all in its four thousand years of making; when we study it more closely we see the impress of successive epochs. The sturdy, broad figures of the earlier centuries gave place to more slim, more elongated forms; presently the time of falling-off comes, followed by a brief period of striving after older ideals. Then Egyptian art ceases to be, dies before the country itself falls apart in the grip of successive conquering nations. It has been said that for sheer technique in their art the sculptors of Egypt have never been surpassed. In spite of their excellence in this respect

they were strangely unable to get away from certain curious conventions. We have already learned something of these in connection with painting in ancient Egypt.

One convention decreed that the body of a standing figure must be quite vertical; this stiffness, this absence of all bending and curving attitudes, is all the more peculiar to us because no other race since has even remotely imitated the convention. Another law of Egyptian art, painting and sculpture alike decreed that in all cases both feet—always depicted as huge—should rest flatly and firmly on the ground. The most extraordinary convention of all has been described as the *law of frontality*. This meant that in all cases the shoulders must squarely confront the spectator, and the eye must always be drawn in full, no matter what the position of the face. So that a man who is represented as walking—say, along a frieze—has his head, legs and feet drawn in profile, and his shoulders swung round in full view, and the eye drawn in the large and perfect almond shape which was the Egyptian type of beauty.

THE SCULPTURE OF ANCIENT EGYPT AND THE SCULPTURE OF TO-DAY

Another curious racial characteristic is shown in the exaggerated stillness of the sculptured figures. A great many of them are rigidly seated and appear clamped to their stone benches. The Egyptian sculptor seemed to represent moving figures under protest; it was abhorrent to him to show zest and energy of motion, and powerful muscles in play. He smooths down the figures of his great kings and gods, and is happiest when the faces seem like a mask.

When we think of our fluid and changing forms of art to-day we find it hard to believe that for four thousand years these several conventions should have been firmly held. Of all schools of art, that of Egypt has deserved to live on.

As the religion of the Egyptians was largely animal- and nature-worship, a great deal of brute life in varying forms is shown in their sculptured reliefs and statuary. The artists made a convention of their animal subjects, often blending the human and brute or bird forms in one body. This constant repetition of animal shapes has a great deal to do with the magnificent decorative power of their reliefs. Shapes so forceful and restrained, planned on such noble lines with all unnecessary detail refined away, could not help making wonderful decoration. The world has never since seen the like, and artists of later centuries have often turned to Egyptian decoration for models or inspiration.

The most remarkable of the many kinds of animal convention that the sculptors of Egypt created was the sphinx—a human-headed lion. The origin of this type is unknown, and about it many legends have clustered.

THE SPHINXES OF EGYPT AND THE WINGED BULLS OF ASSYRIA

Sphinxes were often set in pairs at the entrances to temples; one such hall, built by Queen Hatshepsut, was approached by an avenue of sphinxes. The most famous portrayal of this type of animal is that colossal sculpture near the Great Pyramid at Gizeh—a sphinx 150 feet long and 70 feet high.

The Assyrians, near neighbors of the Egyptians, also had a conventionalized animal form—a man-headed and winged bull, which decorated their halls and palaces, and was sometimes carved in the round but more often in relief. The marked difference between the Egyptian rendering of the sphinx and the Assyrian rendering of the bull shows, in itself, the whole difference between the art of the two nations. Where the Egyptians smoothed down the actual form, the Assyrians and Babylonians insisted on, and rather exaggerated, it; the one ideal was repose, the other brute activity. And so we get the wonderful monuments in the Louvre and the British Museum where each part of animal form is "hammered out," and it would seem that with a little encouragement the muscles would slip the leash of granite, marble or bronze and become alive before our eyes.

THE CRUEL STORY TOLD IN THE ART OF ASSYRIA AND BABYLONIA

The tale that we find in the reliefs, monuments and bronzes that have been preserved of the Babylonian and Assyrian empires is very much like the tale of any Eastern tribe—plunder, battle, triumph, long lines of prisoners, and acres of spoil. In Egypt, as we know, the doings and glories of the gods and the honors of death were the chief themes of the national art. Assyrian art centred, instead, about ideas of cruelty and tyranny. We shudder with horror over

the story in Assyrian reliefs. Those ranks of men so finely sculptured, with their strange angular beards and pointed head-dresses, were either in the act of torturing and killing enemies or marching on to the scene of bloodshed.

Although the Babylonians and Assyrians did not accept the Egyptian law of frontality, they shared the convention of the full-drawn eye in a profile face. And you will notice in the pictures of the winged bull and the winged lion that each one has five legs. This is because the figure stood as a guardian at a gateway, and was to be seen both at front-face and in side view. But, as the form was in raised relief against a wall, one of the two feet of the front view did not show in the side view; so, an extra foot must be represented. This was an Assyrian convention. But the Assyrians surpassed their neighbors in portraying animals. There are few more wonderful things in the whole story of art than the Assyrian reliefs of the wounded lion and lioness in the British Museum. And in other instances we can see how beautifully the Assyrian craftsmen could draw horses.

SWEEP AND INFLUENCE OF EGYPT, ASSYRIA AND BABYLONIA

Although they differ so greatly in foundation feeling, Egyptian and Assyrian sculpture are somewhat akin in hugeness and grandeur. In each case, we may say, their works of art are all that is left of long-enduring and mighty nations whose activities were the heart-beats of the ancient world. In each case their art kept its unity for some four thousand years. Those far-away ages are reckoned in great sweeps of time; but as the centre of civilization moved westward, epochs of art covered periods less and less broad. They fitted into centuries; later, into generations; and in our own times it is generally accepted that ten years will include the life period of a style of art.

The art of Babylonia and Assyria had an even greater effect on the outlying countries than Egyptian art had. We know that it dominated the art of the Israelites, of the Hittites and of the Phœnicians. For example, we have only to read the description of Solomon's Temple to recognize Assyrian influence. The cherubim upon the Ark of the Covenant were unquestionably related to the Assyrian man-headed winged bulls. The Hittites, neighbors and often foes of both Egypt and Assyria, drew more upon the latter country than the former in the matter of art influence, as we can perceive when we look at their sculpture and note how they represented the lion and the human form.

PERSIAN SCULPTURE, SHORT OF LIFE BUT SPLENDID

As for Persian sculpture, brilliant and short-lived, it owed a large debt to both Egypt and Assyria. In the ruins of the gray marble palaces built by Darius and other Persian kings, on the great terrace platform at Persepolis, the heavy columns have something of the hugeness belonging to Egypt's pillared temples, while the details reflect the ornamental characteristics of Assyria. With these elements the Persians combined other ideas caught from neighboring peoples, and the result was a very ornate scheme of decoration. It included the human-headed bulls of the Assyrians and the same magnificent arrangement of reliefs upon the walls. Some of the finest of these, as might be expected, were in the palace of Darius at Susa. Now, parts of the enameled brick friezes from that same ancient capital—"Shushan the palace," where Queen Esther probably once walked about—are to be seen in the Louvre in Paris.

AND AFTER ALL THESE OTHERS CAME GREECE

About three hundred years before the birth of Jesus there came to Susa and Persepolis, Alexander, the conqueror from the west—from Europe. In the halls of the Persian monarchs he paused to feast and to revel in his young glory; and at Persepolis, in token of his newly won supremacy, he set fire to the famous palace of Darius. We shall soon see how, in the two centuries which lie between the conquests of Darius of Persia and the conquests of Alexander of Greece, a few sculptors upon the little peninsula of Greece had had opened to them the door where Beauty lives and had learned more of her secrets than ever have been revealed to anyone else in all the world. Their statues and reliefs, even when marred by time, are the finest expression of man's conception of form. So, after Egypt's display of calm enduring splendor, and Assyria's presentation of vigorous strength came the fine realization of beauty among the hills of Greece.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 3987.

SCULPTURES OF EGYPT AND ASSYRIA


SETI II


KING KHAFRA

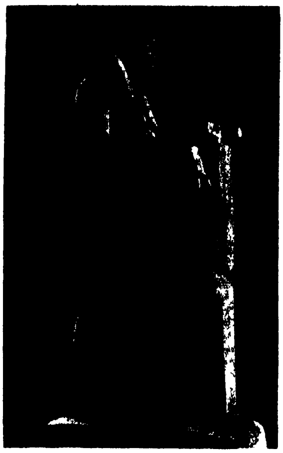

AN EGYPTIAN OFFICIAL


THE SHEIK EL BELED


SETI I


A SCRIBE

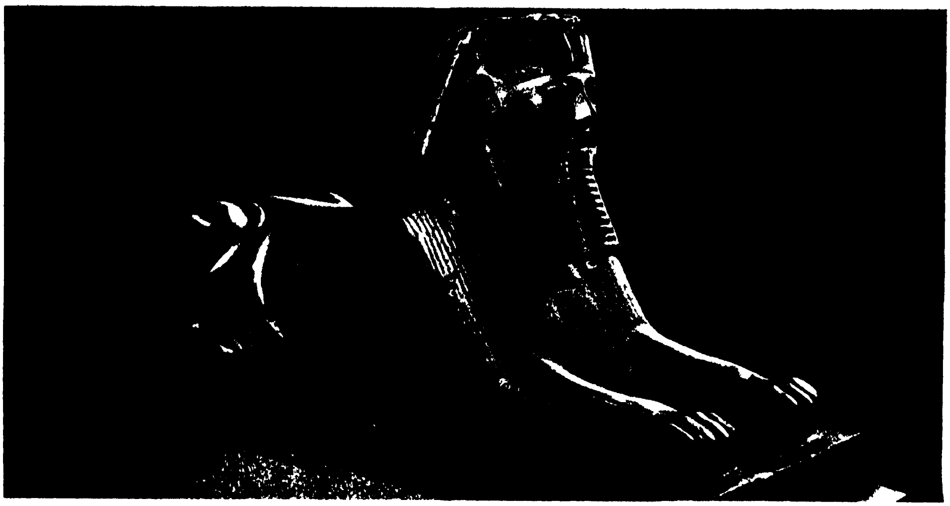

MAHU, DIRECTOR OF WORKS, AND HIS WIFE



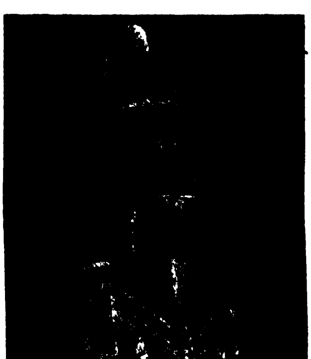
HAPI, THE NILE GOD

A HUSBAND AND HIS WIFE

A STATUE 6 500 YEARS OLD



A SPHINX INSCRIBED WITH THE NAME OF THOTHMES III



RAMESES THE GREAT

AMENHOTEP III

SHRINE OF THE GOD OSIRIS

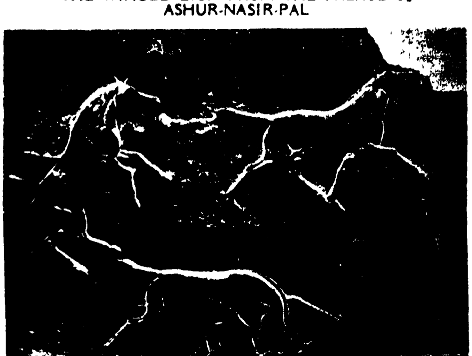
A HEAD 5,000 YEARS OLD

GUDEA, KING OF BABYLON

AN ASSYRIAN OFFICER

THE WINGED LION FROM THE PALACE OF ASHUR-NASIR-PAL

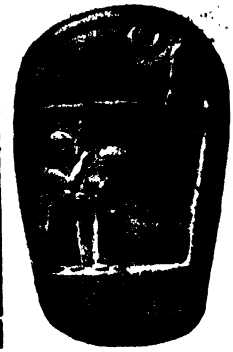
THE WINGED BULL FROM A DOORWAY IN THE PALACE OF SARGON



HUNTING SCENES FROM THE ASSYRIAN SCULPTURES, NOW IN THE BRITISH MUSEUM

THE ASSYRIAN GOD NEBO

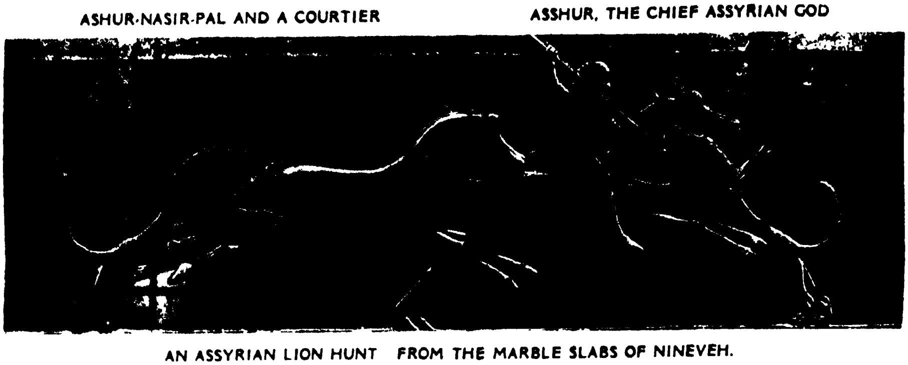
ASHUR-BANI-PAL LEADING HIS HORSES—A MARBLE SLAB FROM NINEVEH



A BOUNDARY STONE FROM ANCIENT BABYLON

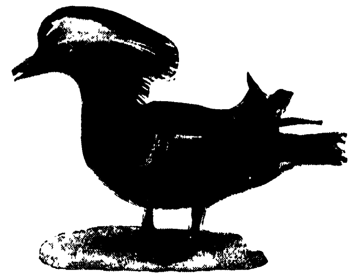
ASHUR-NASIR-PAL AND A COURTIER

ASSHUR, THE CHIEF ASSYRIAN GOD

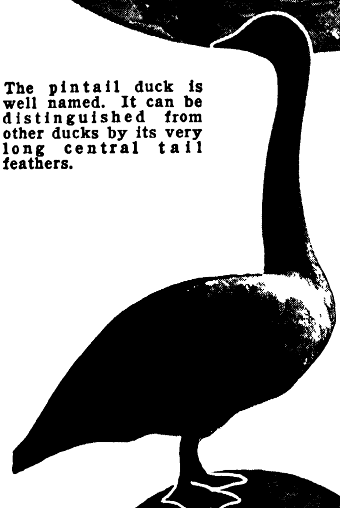


AN ASSYRIAN LION HUNT FROM THE MARBLE SLABS OF NINEVEH.

The pintail duck is well named. It can be distinguished from other ducks by its very long central tail feathers.



The shaggy crest and ruffled plumage of the mandarin duck give it a rather comical look. It is found in Asia.



The trumpeter swan, whose cries herald spring as it flies north in great flocks.

A fluffy baby pintail duck, still a little wobbly. Soon it will waddle to the water, and grow beautiful feathers.

DUCKS and GEESE

THERE is great variety in form and habit among nature's winged creatures. The swifts, the swallows, the humming-birds and the hawks are perfectly adapted to life on the wing. In this article we shall tell you about certain water birds—ducks, geese, swans, cormorants and others—which are as much at home in the water as they are in the air. For while they rival the swift and the hawk in flight, they also have extraordinary feet for swimming.

Early man hung a skin on a pole to catch the breeze and thus to move the log that he used as a boat. A later man broadened and flattened the end of another pole and used it as an oar. Modern man perfected the screw propeller to drive his steamship.

Nature has developed a simple device that does for certain birds what sails and oars

The stately black swan is an Australian bird. The glistening black wings are tipped with white, and the long bills are a deep red.

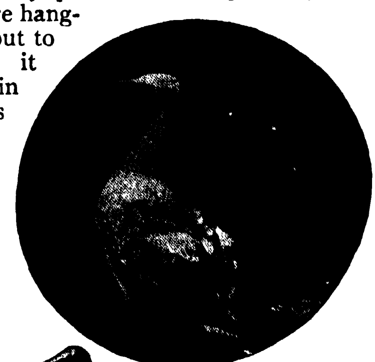
Pictures: Pintail, Allan D. Cruickshank from NAS; baby pintail, William L. Finley from NAS; others, from New York Zoological Society

and screw propellers do for our ships and boats. A hen has to seek its food on land. A duck can take to the water and find an entirely new source of supply. One of the chief differences between the duck and the hen is that the duck has grown a tough skin which connects its toes with an elastic, muscular web. With this web the duck pushes its way through the water.

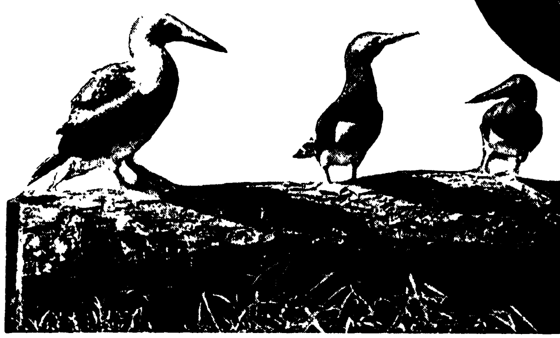
The webbed feet of the birds that we are going to describe open to them the lakes and rivers and oceans of the world. These birds can fly to every sea and navigate them all. They tread upon the earth; they swim on the surface of the sea; they sail through the air with amazing power and endurance.

The cormorant is one of the most picturesque of all water birds. One or more of the thirty species of cormorants are to be found in every part of the world where there are large bodies of water. Even in Greenland they find abundant food. The common cormorant and the double-crested are best known in our waters, though the smaller Florida cormorant and the Mexican cormorant live in the south and, occasionally, wander northward.

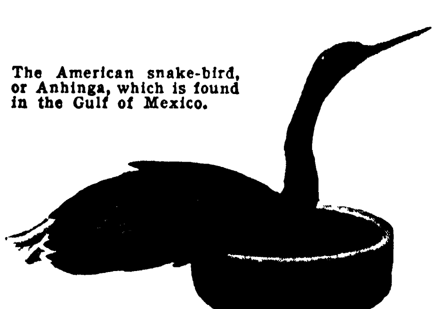
The cormorant is a large black bird, averaging about three feet in length, from tip of beak to tip of tail. Cormorants love company when they breed. They generally select steep cliffs for their nests, which consist of masses of seaweed. These birds have enormous appetites. A cormorant will eat and eat even when its stomach is already packed with food. When it has gorged itself, it likes to sit on a lofty perch with wings outspread, as if it were hanging them out to dry; and it will remain motionless in this position for hours.



The gannet, or solan goose, is a sea bird whose outstretched wings may measure six feet across.



These boobies seem to be enjoying a pleasant conversation in the warm sunshine. They are tropical sea birds, smaller than the gannet.



The American snake-bird, or Anhinga, which is found in the Gulf of Mexico.

The cormorant is awkward aground. But when once it takes wing, how graceful, how strong and unwearying it is! Down on the water it has something of the submarine's qualities. It can swim with its back awash, it can swim under the water, it can lower its long head and neck beneath the surface, like an inverted periscope, and fish as it travels. It can dive from a height and snatch up prey with speed and precision.

The cormorant can be tamed easily when it is young, and can be trained to catch fish for its master. Many Chinese fishermen use cormorants in this way; they fasten a strap around the bird's neck so that it will not be able to swallow its catch. Fishing with cormorants was once common in England and in continental Europe. There was a time when the master of the cormorants used to be an important officer of the English royal household.

In Asia and in many other areas of the world we find the darter, or snake-bird, which resembles the cormorant. It is rather more slender and has a longer neck and tail. Only one species of this bird is found in the United States—the Anhinga, which is an inhabitant of the Gulf states.

Darters are birds of river, lake and swamp. They perch on rocks and trees by day, and fly in great flocks to fish in their favorite

waters toward sundown. It is easy to see why darters have been given the name of snake-birds. They swim with their bodies deep in the water so that only the head and neck are above the surface. And the neck looks very snake-like indeed as the bird makes its way along the surface with the head darting this way and that in search of prey.

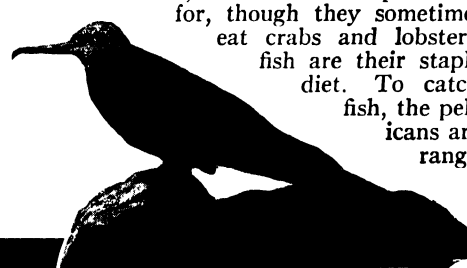
The gannet, or solan goose, is related to the cormorant and the darter. This large bird has a white coat of feathers, with black at the outer edge of the wings. It ranges over the whole of the North Atlantic between breeding seasons. We see it flying high in the air, watching with keen eyes the wrinkled sea beneath. It catches sight of its prey—a school of mackerel or herring. Suddenly the bird, changing from a level keel, seems to stand on its head in the air. Then down like a great white dart it flashes into the midst of the school.

Gannets breed together in great numbers in various coastal areas of the North Atlantic; two of their most famous breeding places are Bird Rock, in the Gulf of St. Lawrence, and Bass Rock, in Scotland's Firth of Forth. The birds nest so thickly together that their home, seen from afar, suggests a great white sail on the horizon. When thousands rise from their roosting-places into the air all together, it looks as if the sail were flying upward.

Though the gannet is sometimes called the booby, that name really belongs to a smaller species which seldom comes farther north than Georgia. It is dark brown above, white below, and is a little smaller. It does seem stupid, and may be knocked down easily.

Next we come to the pelicans, which are found in many parts of the world; there are two species in North America. The pelican is one of the larger water birds; it is a comical-looking creature, walking with a droll, waddling gait on its short legs. The lower half of the beak consists mostly of a huge skin pouch attached to the outer rim of the jaw; the straight upper half of the beak forms a sort of lid to the pouch. Yet there is beauty in its white plumage, tinged with pink. There is wonderful grace in its powerful, measured flight from one feeding-place to the other.

Pelicans dwell along the shores of large rivers and lakes, where fish are plentiful; for, though they sometimes eat crabs and lobsters, fish are their staple diet. To catch fish, the pelicans arrange themselves in a long line in the form of a half-circle. They then swim from deep water into shallow, driving the terrified schools of fish before them. At last the birds lower their great bills and gobble. Then they waddle ashore and, dozing, happily digest their meal.



The frigate, or man-of-war, bird is swift and streamlined, and a greedy thief.

Pictures on these two pages, New York Zoological Society

Three European white pelicans "listen" with polite restraint while a California brown pelican squawks in argument.

People used to believe that the mother pelican fed its young with blood drawn from its own breast. Nowadays we know that this is only a legend. The legend has found a place in Christian art. The pelican offering its life-blood to its young was taken to represent the Holy Eucharist—Christ feeding mankind with his own body and blood. That

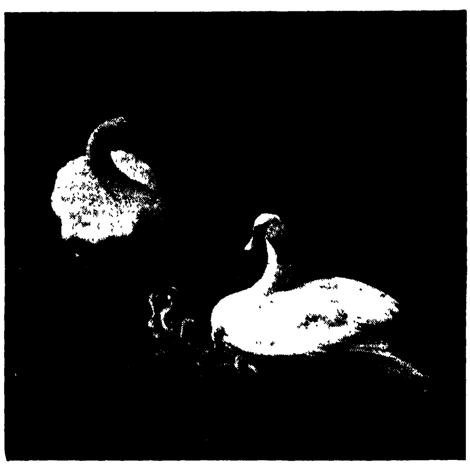
is why we find the pelican in the stained windows and mosaics of churches, and enameled in crimson and white on sacred vessels.

The webs on the feet of the pelicans are very wide; they are slight on the feet of the frigate bird, also known as the man-of-war bird. This bird is found in the warmer parts of the world, particularly along the shores of the Atlantic, Pacific and Indian oceans. The frigate bird is a handsome creature with dark-brown plumage; it is a superb flyer, swift and sure of wing. It does little work on its own account, but preys upon other birds.

While honest birds go out to fish, the frigate birds idle about. They come forth from their retreats at last as their victims come home from fishing expeditions. Boobies and terns are heavy with good feeding. They can not escape the swift frigate birds, which chase and knock them about pitilessly. At last the victims cast up some of their fish and fly for safety. The frigate birds need nothing better. Fast as a fish falls from on high, still faster is their downward swoop to catch it. In mid-air they snap up their booty as surely as a dog catches a biscuit thrown it.

The tropic birds are as swift as the frigate birds, and even handsomer. They are white, with black on the wings and tail, and the legs are a bright yellow. Both the red-billed and the yellow-billed tropic birds occasionally venture into the United States, but their home is in the tropics. They are particularly abundant in the South Seas. They can outfly our swiftest steamers, keeping them company for miles.

Temperate lands possess many of the birds that we are now going to discuss—swans, geese and ducks, which all belong to the family of the Anatidae (ah-nat′-ih-dee). Some of them are seen only in the aviaries and sheltered houses of the zoo. But we have our natives, and we have our millions of winter visitors, coming down each autumn from the harsh North. They are powerful of wing, strong of leg and so shaped that they offer a minimum of resistance to the water as they thrust their way forward. Many of them, however, find themselves greatly handicapped when they molt, or shed their feathers, for they lose some of the feathers of the wings and can not fly for a time.



Papa and mamma swan view their brood of cygnets with pride. These handsome birds are mute swans.

The swan is the handsomest of the Anatidae. On land it is rather awkward, like so many water birds; but on the water it rides with exquisite ease, its long neck beautifully arched. The best-known species is the mute swan, so called because it has no true voice, but can only hiss. There are wild mute swans in northeastern Europe and central Asia. The bird is found in a semi-domesticated (half-tame) state in many parks of Europe and America. Its plumage is white; its beak, which has a large knob at the base, is orange; its legs are black.

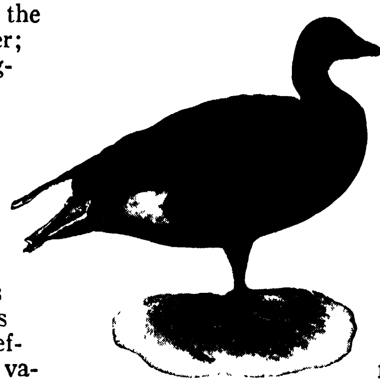
The mute swan builds a large nest, made of plants that grow in the water, and it lays from five to ten olive-gray eggs. The baby swans, known as cygnets (sig′-nets), are gray in color and are anything but beautiful. They suggest, indeed, the "ugly duckling" of Hans Christian Andersen's famous tale. (See the story as we have told it on page 3711.)

Europe has two other species of swan—the whooper and Bewick's swan. They are distinguished from the mute swan by the absence of a black knob at the base of the bill and also by their loud and ringing cries. There are two species of wild swans in North America. The whistling swan breeds in the Far North and winters along the South Atlantic. The trumpeter swan also breeds in the North, but winters in the interior of the continent. There is a black-necked swan in South America, and a black swan in Australia.

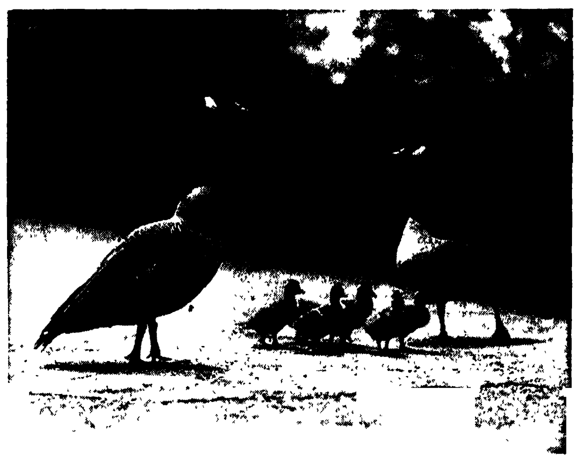
According to an old legend, the swan at the very end of its life sings one last and very sweet song. The legend, which is not founded on fact, has given rise to the phrase "swan song"; this is generally applied to a last musical or poetical work.

We now come to the geese, which form

the link between swans and ducks. It is rather hard to divide geese and ducks into two definite groups. However, generally geese are somewhat larger in size; their bills are shorter; their legs are longer and are placed nearer the center of the body. Furthermore, both parents care for the young, while the male duck leaves that task to the female. The male of the goose is called the gander; the young birds, the fledglings, are called goslings.



For some reason or other the goose has come to be considered a stupid sort of creature. We say, for example, of a foolish woman that she is a goose. It is hard to tell how the goose won this reputation; perhaps it is due to the rather comical effect produced by the tame varieties as, with their heads nodding pompously, they waddle along in a group. Certainly there is nothing stupid about the wild goose.



Both pictures, New York Zoological Society

Wild geese. At top is the graylag, found in the Eastern Hemisphere. Below is a family of Canada geese, with their adorable goslings. This species is the most common in North America.

Generally geese prefer temperate and cold lands. They are splendid flyers and swimmers, but they depend chiefly upon a vegetable diet. A flock of geese will crop the grass of a pasture closer than cattle. It is believed that the domestic geese of Europe which were brought to North America were derived from a wild species—the graylag. It is found in Europe, Asia and Africa. Some of the larger varieties of domestic geese came from China to Europe. Selection has done wonders with them.

North America has ten or twelve species of wild geese, most of which breed in Canada or Alaska and spend their winters in the United States. The Canada goose is the most common species. It is grayish brown, with black tail and neck and a white patch under the throat. The greater snow goose is found in the East, while the lesser snow goose breeds in Alaska and is rarely seen east of the Mississippi.

The brant is a large blackish brown goose found both in Europe and eastern America, while the black brant, a smaller species, is seldom seen except in the West. Other American species are the blue, the white-fronted and the barnacle. In migrating, geese generally fly in the shape of a great V, with an old gander in the lead.

There are some strange varieties among geese. The pied goose, for example, is a half-webbed Australian. Its claws are long and sharp for perching. The spur-winged geese of Africa are long-legged; they are quick walkers and runners and they make clever pets. They have a long, sharp spur on each leg—the so-called spur wing—and they fight like gamecocks. The tree ducks of South America are really geese which often make their nests in hollow trees far from the water, a strange habit. Some of them visit the United States. Australia has a curious bird in the Cape Barron goose, whose beak is remarkably short.

The breeding of geese is carried on extensively in many countries. The standard varieties of domestic geese in the United States and Canada are the gray Toulouse, the white Embden, the gray African and the Chinese goose. Geese are raised principally for their meat; their eggs are also considered a delicacy by some people. In Strasbourg, Toulouse and other places in France geese are sometimes crammed with salted grain; they keep feeding away until they almost burst. The liver of such birds is uncommonly large. From it is made the famous

pâté de foie gras (pah-tay' duh fwah grah), or "paste of fat liver." Imitations of the French *pâté de foie gras* are now made in various other countries.

The feathers of geese are used to stuff pillows and similar objects. They also serve as ornaments for women's hats—that is, during the periods when it is considered fashionable to have feathers on hats. Formerly the quills—the large, stiff feathers of the wings and tail—were used as pens. The tips of these quills were specially shaped and sharpened for this purpose.

We now come to the very numerous family of the ducks. The duck is a sturdy creature; its short legs, set far back, and its fully webbed feet make it a powerful swimmer. It is a good diver; in fact, the word duck comes from the Anglo-Saxon word *dūce,* which means the bird that ducks. The duck is also strong and swift on the wing. The male of the duck is known as the drake; the young are called ducklings.

Ducks may be divided into two classes: fresh-water ducks and sea ducks. The fresh-water ducks, which live and breed along rivers, lakes and ponds, are not such expert divers as the sea ducks. They prefer shallow or marshy waters, where they can pick up food from the bottom without diving deeply. They also feed along the banks.

The best-known fresh-water duck is the mallard, which is common throughout the whole Northern Hemisphere. This handsome bird, from which many of our domestic species of duck are derived, is much sought by hunters. Another familiar species is the black duck, also known as the black mallard. It is common in the eastern part of the United States, but is not found in the Old World. The gadwall, or gray duck, is common in both North America and Europe, but is so shy that it is seldom seen.

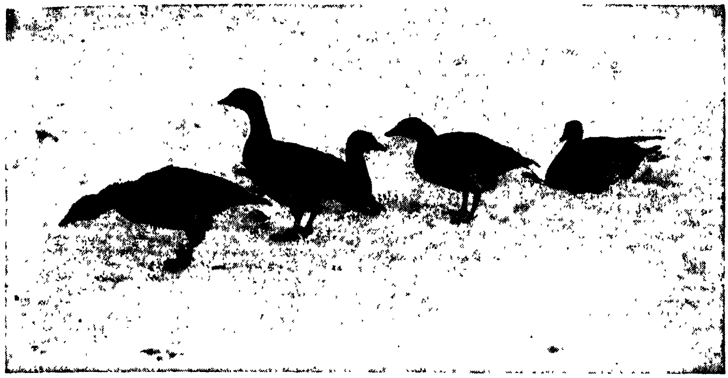
The European widgeon frequently visits the Atlantic coast of North America. The American widgeon is better known as the baldpate; it is so called because of its white crown. It ranges all over the continent; its loud, whistling cry is known to all gunners. Teals are found in many areas of the world. There are three American species. In the East we find the green-winged and the blue-winged teals, noted for their swiftness of flight and their mellow, whistling notes. A third species, the cinnamon teal, is found in the West. It takes its name from the color of its underparts, more noticeable in flight.

Two lower pictures, New York Zoological Society

That delicious roast duck you had for dinner was probably a Peking duck like this white one.

The green-winged teal is one of the most brilliantly colored ducks. It skims through the air swiftly, uttering a musical whistle.

Mallard ducks take their ease on the snowy bank of a fresh-water pond. These ducks are found all over the Northern Hemisphere.



Brants. Like most geese, they prefer temperate or cold climates and feed on grain or berries.

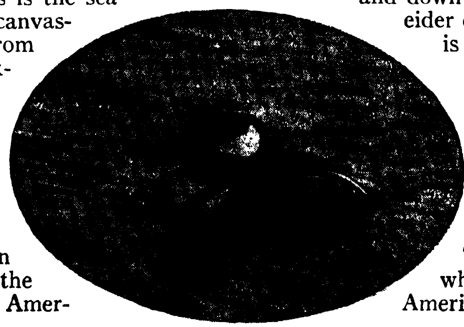
Both pictures, New York Zoological Society

White-faced tree ducks in a fond moment. They are really geese, and do nest in trees.

The shoveler is most common in the Mississippi Valley; its name comes from its large, broad bill, which looks a little like a shovel. The pintail, found on both sides of the Atlantic, may be easily recognized by the two long central tail feathers. The most beautiful of all the fresh-water ducks is the wood duck. We tell you about this exquisite little bird in the chapter called Birds of the South.

The sea ducks are mainly to be found in or near salt water, though they sometimes seek their food in rivers. They feed chiefly upon shellfish and the roots and seeds of plants that grow in the water. They obtain their food by diving, sometimes reaching a depth of 150 feet or so, in a gliding plunge.

A favorite of hunters is the sea duck known as the canvasback. It gets its name from the fine, wavy, black-and-white cross-markings that cover the hind part of its body. The flesh of the canvasback is delicious. Closely related to the canvasback is the redhead, which is found in great numbers along the Pacific Coast of North America. The scaups are dark-colored, white-bellied birds. Other important sea ducks are the ruddy, the ring-neck, the golden-eye, the scoter and the eider duck.



Allan D. Cruickshank from NAS

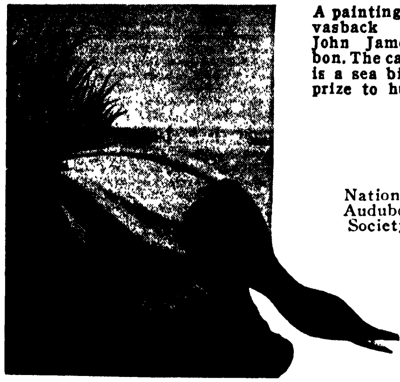
A hooded merganser, or fish duck. It is an expert diver and may go deep beneath the surface to seize a fish.

The eider duck is particularly famous for its down, which is used to stuff pillows and coverlets. This sea duck is found in many northern regions, particularly in Labrador, Newfoundland, Greenland, Iceland and Norway. It breeds on rocky coasts in vast colonies. Its nest is formed of grass or dry seaweed, lined with down which the female plucks from her breast.

In this soft bed the female lays half a dozen eggs, which she covers over with down. The natives remove both the down and the eggs, but the eider duck is not discouraged. She lays some more eggs and these, too, are carefully covered with down. Again the eggs and down are removed; again the eider duck provides more. She is permitted to hatch at least one lot of eggs; the down is picked up in this case only when the young have left the nest.

There are about a dozen different varieties of domestic ducks. The white Peking duck, which was introduced into America and Europe from China in the last century, is highly prized as a "table duck"—that is, for its meat. Other popular kinds are the white Aylesbury, the muscovy and the Cayuga. Several species of wild ducks are kept in captivity by clipping their wings. It is quite profitable to raise such wild species as the canvasback, the black duck and the teal.

Some people add a third group to the

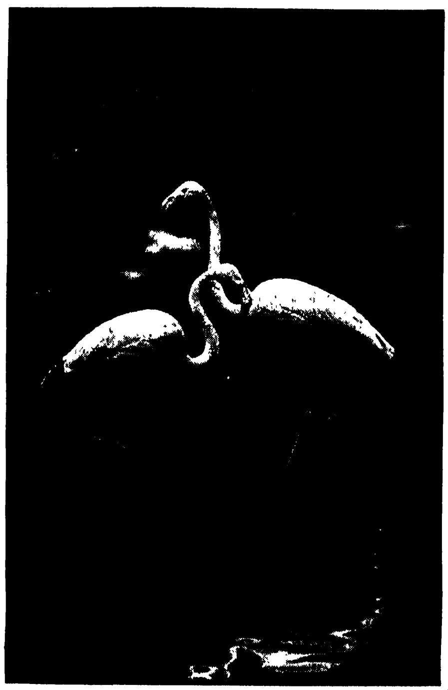


A painting of a canvasback duck by John James Audubon. The canvasback is a sea bird, and a prize to hunters.

National Audubon Society

family of ducks — the mergansers, or fish ducks. Most people hold, however, that they form a separate group of the Anatidae. The merganser is distinguished by its slender, cylindrical bill, the upper part of which ends in a sharp hook, pointing downward. The best-known species is the red-breasted merganser, known in America as the sheldrake. Other members of the group are the goosander, the nun, the smew and the hooded merganser. All mergansers feed upon fishes; they dive deeply for their prey.

Next we come to the odd flamingo. The coloring of this bird is beautiful—light vermilion in some species, white with a rosy tinge in others. Because of its long neck and legs, the flamingo resembles the stork and the heron, but it is more closely related to the members of the Anatidae family—swans, geese, ducks and mergansers. The six species of the flamingo are widely scattered over the warmer regions of both hemispheres. The American varieties are to be found along the Atlantic coast from Florida to the mouth of the Amazon River.



The rosy coloring of the flamingo makes it a gorgeous sight against the dark green of swamps.

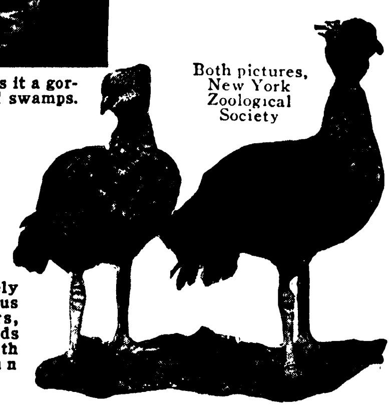
The flamingo has a truly remarkable beak —large, swollen and bent downward toward the middle. The bird holds its head upside down while it feeds, and the amazing beak forms a kind of scoop. With this the flamingo shovels shellfish and worms from the bottom of the marshes where it dwells.

Flamingoes live together in large flocks. They warn one another of danger by a loud trumpeting note, which is the signal for the flock to take wing. The birds breed in mudflats or marshes. The nests are cone-shaped structures of mud, rising a few inches above the surface of the water.

Another strange water bird is the screamer, which lives in Guiana and the Amazon Basin. This bird is about as large as a turkey. Its toes, which have only a fragment of webbing, are long and powerful, as are its feet. It has two sharp spurs on each wing. The skin yields and crackles as one touches it, because of the air cells beneath it. In some species the head is crowned with a slender horn more than three inches long. Screamers flock together, flying at an immense height and uttering loud screams at intervals, making the air hideous with noise.

And now we take leave of these webfooted friends, creatures at home in all three elements—the land, the air and the water.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 4004.



Both pictures, New York Zoological Society

The homely and pompous screamers, water birds of the South American tropics.

T. F. Healy Collection

The parsonage and church on the bleak, lonely moor at Haworth, in Yorkshire, where the Brontë sisters lived.

GREAT STORIES *and* *GREAT* STORY-TELLERS

ENGLISH FICTION IN THE NINETEENTH CENTURY

DURING the nineteenth century—beginning with the year 1800 through the year 1899—some of England's greatest writers lived and worked—poets, writers of essays and novelists. We tell you elsewhere in our book about the important poets and essayists. We give a separate chapter to the stories of Dickens and Thackeray, and another chapter to the novels of Sir Walter Scott, for those three stood head and shoulders above even the other giants.

During about two-thirds of this century, 1837-1901, Queen Victoria sat on the throne of England, and so the period is sometimes called the Victorian Age. The writers are often called Victorian novelists or poets or essayists. The Victorian Age was in many respects a period of growth and progress. But, as we tell you on page 2293, the progress did not come smoothly.

The England of the nineteenth century was an England torn by social upheaval; political strife verged on revolution. In the space of a few decades, England had changed from an agricultural country where the principal manufacturing had taken place in the home to a state in which the wealth of the nation was dependent upon industry. Her population had shifted from field to factory. The factory wages were low, so low that the condition of working people was desperate. Since literature usually reflects the conditions of life in which it is created, it is no wonder that the novelists of the century wrote so many novels having to do with the troubles of the times.

Each writer had his own cure for the ills of the day. The great Benjamin Disraeli, Lord Beaconsfield, the prime minister, wrote several novels on political and social themes in which, while he sympathized with the workingman, a plea was made for a strong and responsible aristocracy and church. Other points of view are seen in the principal social novelists of the times, Charles Dickens, Charles Kingsley, Harriet Martineau, Elizabeth Gaskell and George Eliot.

Charles Kingsley (1819-75), a scholar and clergyman, is best known for WESTWARD HO!, a fine historical novel, but his main interest in life was in social questions. He produced several novels such as YEAST and ALTON LOCKE in which he set forth his solution of the grave problems that were disturbing England. He called for a rebirth of the Christian spirit in both church and state and among both employers and workers. But not all of Kingsley's books were so serious. WESTWARD HO! is a vigorous tale of patriotic adventure, intrigue and naval warfare set in the days of Queen Elizabeth. The hero, Amyas Leigh, sails around the world with Sir Francis Drake, loses his sweetheart to a rascally Spanish captain,

Don Guzman, fights the Spanish Armada and meets an exotic Indian princess during his wanderings in South America. Another story by Kingsley, THE WATER BABIES, is a charming fairy tale about a human child who was equipped with gills for breathing like a fish so that he could, and did, live under water. These two—WESTWARD HO! and THE WATER BABIES—will probably always be the most popular of Kingsley's works.

Elizabeth Cleghorn Gaskell (1810-65) was the wife of a Unitarian minister. Her life was more happy and tranquil than the lives of most writers. She devoted herself almost exclusively to social themes. Living as she did in the industrial center of Manchester, Mrs. Gaskell saw with her own eyes the terrible conditions of the factory workers; and she wrote her first novel, MARY BARTON, around the social troubles of the years 1842-43. This is the story of a plot on the part of some impoverished workers to murder their employer as a warning to his class. The lover of the heroine is suspected of the crime which is actually committed by her father; and the most dramatic part of the book concerns Mary Barton's successful efforts to prove that her lover was innocent without casting suspicion of guilt upon her father.

Charles Kingsley, who wrote a beautiful fairy tale for children, WATER BABIES.

The publication of this book, which was severely criticized by some as being hostile to the employers, put Mrs. Gaskell in touch with many of the notable literary figures of the times. Charles Dickens was one whom she met, and during some years afterward she wrote for two of his magazines. She continued to write from the point of view (advanced for those days) that the solution to the troubles of the times was a better understanding between the employer and his workers. Her later works, RUTH and NORTH AND SOUTH, found Charles Kingsley as one of her ardent champions. Mrs. Gaskell also wrote a brilliant life of Charlotte Brontë, one of the most vivid writers of her time. We shall tell more of Charlotte Brontë later. Best known today of Mrs. Gaskell's books is CRANFORD, a simple story of life in "genteel" circles of a small town. The novel is written with unusual humor and charm.

Of all the novelists of this time who devoted themselves to social themes, next to Dickens we always think of George Eliot (1819-80), author of SILAS MARNER, ADAM BEDE, ROMOLA and THE MILL ON THE FLOSS. Born Mary Ann Evans (she took the name George Eliot almost at random when she began to write), this great novelist was certainly one of the most learned women even of an age which abounded in women of talent. From her earliest childhood she was deeply religious. For many years before she began to write novels she busied herself with vast reading on scholarly subjects and the translation of profound works on philosophy and religion. This intellectual background has led some critics to claim that George Eliot is the first modern novelist, and certainly her works seem quite different from those of Dickens or Thackeray or Jane Austen.

George Eliot must always write on a theme and come to conclusions about life and the nature of man. She did not see her novels first of all in terms of a person or a scene. She first thought of what might happen to a man, and then she figured out what kind of man he would be to whom such things happened. Here, for almost the first time in the English novel, we meet a novelist who has no need for the standard tricks of plot with which other writers have had to move their characters.

In SILAS MARNER, the hero is an elderly bachelor, not a romantic lover; THE MILL ON THE FLOSS does not have a happy ending; MIDDLEMARCH has really no central figure at all. Since George Eliot was most interested in following an idea, what happens in her stories is always the logical result of that idea.

George Eliot's first novel was called SCENES FROM CLERICAL LIFE. ADAM BEDE was her first major work. This is the story of the love affair between Hetty Sorrell and Adam Bede which is tragically destroyed by Hetty.

In THE MILL ON THE FLOSS, George Eliot creates her most moving characters, and

Courtesy, Houghton Mifflin Company
"Spearing eels and sneezing," on a crescent moon, one of W. Heath Robinson's illustrations for Kingsley's WATER BABIES.

Maggie Tulliver, the heroine of this story, is one of the most enduring heroines in all fiction. Maggie is the daughter of the miller of Dorlcot Mill on the Floss; and much of the story is taken up with the conflict between Maggie's love for her prosaic, narrow brother Tom, and Tom's interference in her love for Philip Wakem, the son of a neighboring lawyer. The story ends tragically in Maggie's death as she tries to save Tom from the roaring flood which engulfs the mill.

SILAS MARNER is another novel in which George Eliot skillfully portrays characters from humble life. The story of how Silas Marner, an embittered miser, is changed by his love for a castaway child is one of the most wonderful of all of this great writer's works.

ROMOLA shows how great was George Eliot's mastery of history and general philosophical knowledge. This novel is set in Florence at the end of the fifteenth century, and is peopled with the great political figures of the time who are woven into the touching story of the girl Romola.

Many other novelists of the nineteenth century gained ideas from the changing social conditions in which they were brought up. One of the most important of these is Anthony Trollope (1816-82).

Trollope's father was a gentleman and a scholar who frittered away his inheritance and reduced the family to a state of bitter poverty, which Anthony described vividly in his autobiography. But he owed to his family one debt, for his mother turned to writing as a means of supporting her children. It was through her influence, undoubtedly, that Trollope also took to writing. Though he maintained himself for more than thirty years as a clerk in the general post office, he found time to write many novels.

Anthony Trollope's most famous novels are the Barsetshire series which consists of the following books: THE WARDEN, BARCHESTER TOWERS, DR. THORNE, FRAMLEY PARSONAGE, THE SMALL HOUSE AT ALLINGTON and THE LAST CHRONICLE OF BARSET. This series of novels revolves around a group of towns in the imaginary county of Barsetshire, and many of the characters appear in several of the books.

Every person and every thing in a novel by Anthony Trollope is described with such great care and precise attention to detail that he will be a gold mine to historians of the future. They will find in his books a completely accurate description of life in the middle nineteenth century. It is one of Trollope's outstanding characteristics that he is able to show his reader many varying kinds of people who live in as many and as varied environments. Nathaniel Hawthorne, the American novelist, said "Trollope's books are as English as beefsteak."

Trollope's stories are to be read for entertainment. Trollope was not trying to prove anything or change anything through his writing. He saw human beings as they are; he liked them; he was tolerant of their weaknesses. He is like George Eliot in that his plots are almost always realistic, logical and probable. The breadth, accuracy and realism of his writing make Trollope much more easy to read today than some other Victorian novelists, since to read most of the great Victorian novelists, since to read most of the great Victorians we must accept much of the Victorian point of view.

Mrs. Gaskell, left, and George Eliot, right, were two of the many women of the nineteenth century who gave life to the novel.

In direct contrast to the social novelists of the mid-nineteenth century are the Brontës—three sisters whose work, although greatly influenced by the time in which they lived, owed its greatness to their own unique qualities of imagination. These three sisters, Charlotte, Emily and Anne, who had two older sisters and a brother, lived a very restricted life in an isolated parsonage on the bleak moors of Yorkshire. They had no wide experience of the world to draw on for their novels. But even as children, they made up stories and in this way furnished their lives with color and drama.

Poverty-stricken for most of their lives, all three girls were forced to try to support their family by teaching and working as governesses. Charlotte and Emily did have a short period of study in Brussels, where Charlotte fell in love with one of her teachers. This experience she used as the basis of her first novel, THE PROFESSOR, written over the pen name Currer Bell, and later developed it still further in VILLETTE.

Sentimental illustration of the type found in many a nineteenth-century novel.

Charlotte Brontë lived from 1816-65. Her best-known novel is JANE EYRE, the story of a young and penniless orphan. After being brought up in an orphan asylum, Jane becomes a teacher and finally governess to a little girl at Thornfield Hall, which is owned by the grim and forbidding Mr. Rochester. Although Rochester at first terrifies Jane, he is attracted by her wit and courageous spirit and falls in love with her and she with him. But Jane discovers that Rochester has a wife—a lunatic who is kept in seclusion at the hall. Jane flees to the beautiful but relentless moors which always play a strong part in all the writings of the Brontës. She is rescued from death by St. John Rivers, a clergyman who almost prevails upon her to marry him even though she is still in love with Rochester. As she is on the verge of accepting Rivers, Rochester appears to her in a vision. She returns to find Thornfield Hall burned down, the wife dead and Rochester blinded and maimed. They are married and she succeeds in making him happy.

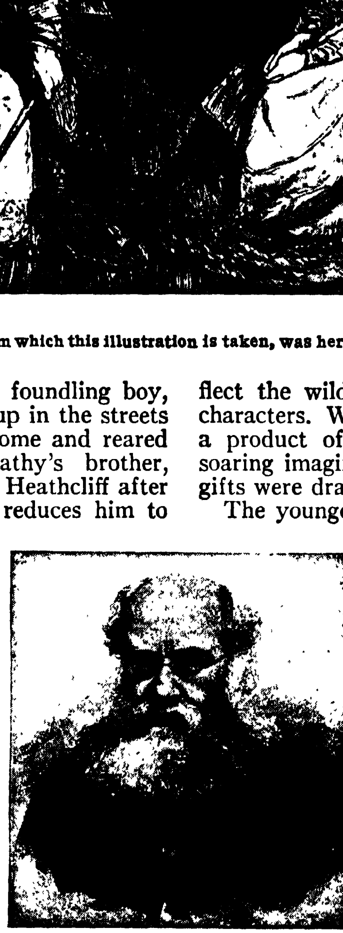
All of Charlotte Brontë's writing has great emotion and passion in it, so that the reader is carried away by the feeling of the characters. Charlotte's capacity for handling emotion shows in all her work. VILLETTE, for instance, tells us a great deal about the feeling Charlotte had for her professor in Brussels. SHIRLEY was a best seller in its day, but is not much read now.

Emily Brontë (1818-48) possessed these romantic emotions in an even greater degree than did her sister Charlotte, and she had a freer and more creative imagination. She wrote over the pen name Ellis Bell. Emily's great work, WUTHERING HEIGHTS, is the story of the love affair between Catherine

Culver Service
George Eliot's SILAS MARNER, from which this illustration is taken, was her best and most skillfully written novel.

(Cathy) Earnshaw and the foundling boy, Heathcliff, who was picked up in the streets of Liverpool and brought home and reared by Catherine's father. Cathy's brother, Hindley, bullies and shames Heathcliff after Mr. Earnshaw's death and reduces him to the position of stable boy. But Heathcliff falls desperately in love with Cathy, who returns his love with one side of her personality—the side that loves the winds and flowers of her native moors and the freedom of the country. Cathy's other side likes the gentleness and security of Edgar Linton.

When Cathy makes a slighting remark, Heathcliff leaves. He returns three years later with a great deal of money, but it is too late—Cathy is married to Edgar. After Cathy's death, Heathcliff's bitterness and desire for revenge are portrayed with great power.



Anthony Trollope.

The great Yorkshire moors play an even larger part in Emily Brontë's work than they do in Charlotte's; and Nature seems to reflect the wild, windswept emotions of her characters. WUTHERING HEIGHTS is far less a product of experience than of the free soaring imagination of a writer whose great gifts were drawn from her own spirit.

The youngest sister, Anne Brontë (1820-49) was not gifted in any similar degree to her sisters. She published two novels, AGNES GREY, which is rather pallid and conventional compared to the brilliant works of her sisters, and THE TENANT OF WILDFELL HALL, a gloomy painful tale, not well told. Anne's pen name was Acton Bell.

In the midst of the nineteenth century with all its serious novels, we also see the beginnings of the detective story which is so popular in our own time. Everyone who likes to read stories of crime and detection sooner or later comes to the two novels of Wilkie Collins (1824-89), THE MOONSTONE and THE WOMAN IN WHITE.

Wilkie Collins, who was a great friend of Dickens and helped him with some of his

plots, was a lawyer by profession, but soon devoted himself entirely to writing. THE WOMAN IN WHITE was first published in Dickens' magazine HOUSEHOLD WORDS. This made Collins the first English novelist who dealt with the detection of crime.

THE MOONSTONE is perhaps even better known than THE WOMAN IN WHITE. It concerns the effort to recover a stolen diamond and the violence which results from its theft. In THE MOONSTONE we meet Sergeant Cuff who is the first detective in English fiction.

Every reader, of course, is familiar with one of Wilkie Collins' successors, Sir Arthur Conan Doyle (1859-1930) whose Sherlock Holmes is the great immortal of detective fiction. Doyle was a physician, but his practice was not a success and he gave it up. However, in his student days he had had as an instructor a skillful surgeon with an unusual talent. This surgeon excelled at figuring out the occupation and character of a man by studying details that most people never notice. Later, Doyle used him as the model for his scientific detective. The earliest of the Sherlock Holmes stories are perhaps the finest. These include THE SIGN OF FOUR, THE ADVENTURES OF SHERLOCK HOLMES and MEMOIRS OF SHERLOCK HOLMES.

After a while Doyle grew tired of writing about Holmes. He killed him off in one of his books so that he would not have to write any more about him. But the public clamored for him so insistently that Doyle revived him and brought him back. Doyle wrote many historical and romantic novels, such as MICAH CLARKE and THE WHITE COMPANY; but he will always be best known for Sherlock Holmes and Dr. Watson, Holmes's man Friday, in whose words the adventures of the great master detective are set down.

The Brontë sisters: Charlotte, Emily and Anne. They were lonely and unhappy; but their imagination was free, and what they missed in their own lives they gave to the world in their great creative novels.

Most of the authors discussed so far have written and thought in ways approved by their time. But when we come to George Meredith (1828-1909) and particularly to Samuel Butler and George Gissing, we encounter three novelists who stood out sharply from the field.

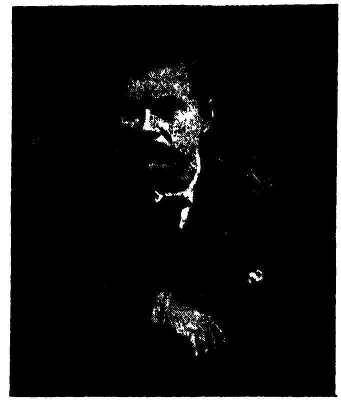
George Meredith, who was a poet of some merit, spent most of his life in journalism and publishing and at one time contributed to Charles Dickens' magazine HOUSEHOLD WORDS. As a poet, he met and was influenced by Swinburne and Rossetti and others of the pre-Raphaelite group. At one time

he lived with Rossetti and Swinburne. (See the Poetry Index for poems by these two men.)

Meredith is interesting because he represents the new, completely intellectual approach which became dominant in the middle of the nineteenth century. Meredith even went beyond George Eliot in his intellectualism. He was charmed by the realism of certain French writers of his day; and he was deeply influenced by theories and methods of Charles Darwin. In fact, he took Darwin's theory of evolution over from science into philosophy, where he expounded the theory that there was an evolution going on in the realm of the soul and spirit which at some vague future date would result in a great flowering of the human spirit.

Some of Meredith's most notable works are THE ORDEAL OF RICHARD FEVEREL, DIANA OF THE CROSSWAYS and THE EGOIST. THE ORDEAL OF RICHARD FEVEREL is the story of a young boy brought up according to his father's rigid plan. This upbringing results in tragedy, for a boy is not a machine but a human being. THE EGOIST is completely different from the great body of Meredith's work and indeed from most of the writing of the nineteenth century. It is more character sketch than story, and is written with polished merriment. Its form provided Meredith with a good way of satirizing the English temperament, which he does in very mocking fashion throughout the book.

Meredith's novels are not easy to read. You must keep your wits about you if you want to understand them completely, for Meredith was a brilliant man, with a keen, sharp mind which he liked to show off. He hid his meanings sometimes in roundabout ways of expression.



Arthur Conan Doyle, creator of the Sherlock Holmes mysteries.

Like Meredith, Samuel Butler was interested in science, particularly in the new scientific thought of the century. Born in 1835, Butler had a distinguished career at Cambridge and then wrote a series of articles on Darwin and THE ORIGIN OF SPECIES. Butler wrote several books on art and was himself a painter. He was interested also in philosophy and in the entire social scene. His novels, particularly the two best known, EREWHON and THE WAY OF ALL FLESH, are satiric pictures of English life. In these, with strong irony, Butler pointed out that the high moral purposes, intellectuality and interest in science of the Victorian time were becoming a set pattern tending to deprive human life of vigor, originality and creative thought.

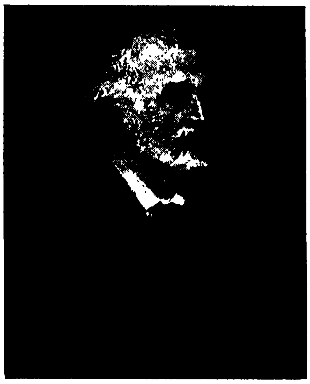
Butler was so much in revolt against his time that THE WAY OF ALL FLESH bears little relation to any of the other fiction of the Victorian era. Butler himself said that he threw into this novel almost everything that he had seen happen. His judgments on the English life of the day were severe; but Butler was an essayist of great merit, as well as a novelist, and his essays reveal a different man—witty, enthusiastic, beauty-loving.

Culver Service

Sherlock Holmes receives a client. He has, no doubt, already made deductions which will astound his good man Friday, Doctor Watson.

George Gissing (1856-1903), like Dickens and some of the other social novelists of the nineteenth century, wrote chiefly of poverty and poverty-stricken people. Gissing, however, was able to find in the life of the poor no such rich vein of humor as Dickens mined, and he showed none of Dickens' delight in picturesque characters. To Gissing, the life of the deprived and the oppressed was a terrible and oppressive thing which he described with a grim and relentless realism. He hoped to show in his novels a full picture of the life of the time. In this he failed, because he did not have a big talent—he was too resentful, too petty in his observation of life. Nevertheless, he was an artist in his use of the English language. It has been said of Gissing that "he is one of the few novelists who add to the worth of words by the care with which they are used." NEW GRUB STREET is perhaps his outstanding novel. It concerns the moral problems to be faced in the journalism of his day.

Culver Service
Flint Cottage, where Meredith wrote his later novels.



George Meredith.

Thomas Hardy (1840-1928) was a master in the presentation of the ironies and disappointments of life and love. Most of his greatest work, notably THE RETURN OF THE NATIVE and TESS OF THE D'URBERVILLES, shows a deep affection for the English countryside and a tendency toward realism which was in those days daring and original. Like Trollope, Hardy invented an imaginary county where many of his novels were laid. Trollope's county was called Barsetshire; Hardy's was called Wessex.

In contrast to the dark and ominous note that sounds so heavily in Hardy is the robust, courageous, cheerful spirit of the Scotsman Robert Louis Stevenson (1850-94). Nagged by tuberculosis and exiled by this disease to the South Pacific, Stevenson came to an early death on the island of Samoa, but he left mankind a generous legacy.

There is hardly a young person in the English-speaking world who reads at all who has not been thrilled by TREASURE ISLAND, KIDNAPPED and THE BLACK ARROW. The grace and tenderness of A CHILD'S GARDEN OF VERSES is known in millions of homes, as are THE MASTER OF BALLANTRAE, TRAVELS ON A DONKEY and THE MERRY MEN. In THE WEIR OF HERMISTON he comes closest to approaching the work of Sir Walter Scott. He was astonishingly versatile and excelled in the short-story form, including such masterpieces as MARKHEIM, THE BEACH OF FALESA and DR. JEKYLL AND MR. HYDE.

A great admirer of Stevenson was Sir James Matthew Barrie (1860-1937), a Scot who lived in London most of his life. He was born in the lowland Scotch village of Kirriemuir which he called Thrums when, later, he wrote about it. When he was young, Barrie's family was very poor. His father was a weaver and there were ten children, so that a college education seemed to be out of the question for young James. His mother, however, wanted James to be well educated. Thanks to her determination and brave spirit, he was able to secure a degree from the University of Edinburgh. As fine as anything Barrie ever wrote is his charming and tender biography of his beloved mother, MARGARET OGILVY.

You may know Barrie best as the author of PETER AND WENDY or of THE LITTLE MINISTER. You will find the story of PETER PAN on page 4658 of your BOOK OF KNOWLEDGE. Barrie told about this little boy who

never grew up in a story and also in a play, and wrote one more book about him called PETER PAN IN KENSINGTON GARDENS. If you are one of the millions who have loved Peter Pan, you know that Barrie had an exquisite sense of fantasy as well as a keen sense of humor. This author who had begun life in pinching poverty achieved both fame and fortune as a playwright. Among the most famous of his plays are QUALITY STREET, THE ADMIRABLE CRICHTON, PETER PAN, ALICE-SIT-BY-THE-FIRE, A KISS FOR CINDERELLA, THE OLD LADY SHOWS HER MEDALS, DEAR BRUTUS and WHAT EVERY WOMAN KNOWS.

Toward the close of the century, the great voice of Rudyard Kipling (1865-1936) began to be widely heard. Most of the writers we have talked about so far were, in their several ways, as English as roast beef and Yorkshire pudding. (Stevenson and Barrie were Scots.) Kipling, however, was a colonial—born in Bombay, India, educated in England.

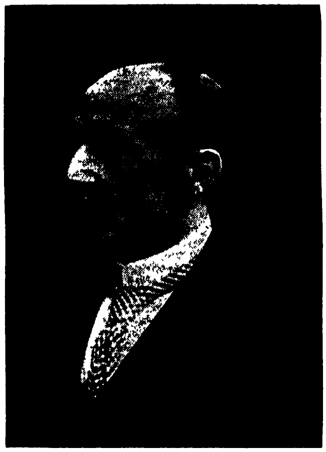
Before Kipling was eighteen, he was back in India working as a newspaper reporter, and in newspaper work he spent almost ten years. All the time he was writing, however —poems, short stories, novels. Before long his name was known in every corner of the English-speaking world. There were people who made a point of reading every word he published. Kipling poems were set to music (DANNY DEEVER; ON THE ROAD TO MANDALAY). Kipling phrases became literary slang (You're a better man than I am, Gunga Din; But that's another story). One novel, THE LIGHT THAT FAILED, was made into a successful play. He grew rich, famous. He won a Nobel Prize for literature and countless other honors.

Relief portrait of Robert Louis Stevenson by Augustus Saint Gaudens. Stevenson was a master of the short story, writing with an air of high romance and a fine, easy-flowing style. His health was broken by disease and often he had money worries, but his writings continued to carry a message of good cheer.

What was the special charm of Kipling? It is hard for us, in this later day, to say. For one thing, he wrote mostly about many aspects of life in far-away India, the life of Tommy Atkins, the common soldier, and of the officers and their wives, of newspaper folk, and of Indian people and legends and animals. Kipling had something more to offer than the glamour of far-away life and the ardor of patriotism. He had superb skill in writing. His style was a clever mixture of sentiment and ruggedness. Compared with most nineteenth-century elaborate plots,

his were streamlined. One older critic, remembering his youth, recently said "When Kipling's stories burst upon the world it was like seeing sunshine after living in dusk."

A note of homesickness strikes through all his stories and poems, for Kipling was in love with England and proud of the great empire of Queen Victoria. He wrote of the glories of empire with such fervor and skill that there were actually people on earth not under the rule of Great Britain who felt neglected and as though they had missed something special.



Culver Service
Thomas Hardy.

Those young people who have read Kipling's JUNGLE BOOKS and his playful JUST SO STORIES will never forget them. PUCK OF POOK'S HILL and REWARDS AND FAIRIES are other examples of Kipling's delightful imagination and superb literary skill. One of his best loved books, KIM, has tremendous charm. It is the story of a small boy, deeply involved in adult adventure, dissension and intrigue, written against the colorful tapestry of Indian life. It is also a commentary on the thoroughness of British Intelligence. Kipling's BARRACK-ROOM BALLADS and soldier yarns are salty and hot with the blood of living people. CAPTAINS COURAGEOUS is a top-notch sea story which countless young people still enjoy. In spite of the fact that Kipling was thoroughly British, he lived in America for a number of years and CAPTAINS COURAGEOUS reveals a very considerable knowledge and appreciation of North American ways and spirit.

Among the novelists of the nineteenth century, the three great literary giants were, as we have said, Scott, Dickens and Thackeray. Great, too, were the novelists about whom you have just been reading—the Brontës, George Eliot, Anthony Trollope and Thomas Hardy; Meredith, Charles Kingsley, Mrs. Gaskell, Gissing and Wilkie Collins; Arthur Conan Doyle, Stevenson, James M. Barrie and Rudyard Kipling.

But there were other men and women who, while of lesser stature, still stood well above the crowd in talent and accomplishment. These men and women came from many different walks of life, and they

Ewing Galloway
Throughout his life Robert Louis Stevenson suffered from tuberculosis. He hoped to recover his health in the South Pacific island of Samoa, but he died soon after he moved there. His home in Samoa is pictured above.

thought in many different ways about the world they lived in. The following list, although it is only a brief one, may help to give you an idea of the great richness of variety to be found among the lesser British novelists of the nineteenth century.

One of the earliest writers was Hannah More (1745-1833). She was famous for her religious writings, but she experimented with the novel form in COELEBS IN SEARCH OF A WIFE.

Mary Russell Mitford (1787-1855) was an essayist of great distinction. Her sketches of provincial life are in the tradition of Oliver Goldsmith, but she was not so successful with her one real novel, ATHERTON.

Lively and full of robust humor are the many stories written by Frederick Marryat (1792-1848). He was a captain of the Royal Navy who turned with great success to writing novels of sea life and books for boys. MR. MIDSHIPMAN EASY and MASTERMAN READY are two of the best-known.

Culver Service

Rudyard Kipling never tired of writing bold and robust tales of life in India.

Samuel Lover (1797-1868) was an Irish novelist and song-writer. Perhaps you have sung his ballads RORY O'MORE and THE LOW BACKED CAR, for they are still popular today. Lover's best-known novel was HANDY ANDY.

Edward George Earle Bulwer-Lytton, first Lord Lytton, (1803-73) was tremendously successful as a playwright as well as a novelist. Among his most popular novels are THE LAST DAYS OF POMPEII, EUGENE ARAM and THE CAXTONS.

The editor William Harrison Ainsworth (1805-82) wrote many historical novels. His strong points were accuracy and vividness of description. ROOKWORTH first made him famous.

The Irish novelist Charles James Lever (1806-72) was a creator of colorful characters and dramatic, sentimental plots. Two of his many novels are CHARLES O'MALLEY and TOM BURKE OF OURS.

Dr. John Brown (1810-82) wrote with great sensitiveness and beauty on many subjects, but he was at his best when writing about dogs. RAB AND HIS FRIENDS is his most beloved story.

The story of MOPSA THE FAIRY has delighted countless children and is still a favorite today. Its author, Jean Ingelow (1820-97) was a novelist and a poet as well. Among her best-known poems is the group called SONGS OF SEVEN. Her novels were popular in her lifetime but are not read very much nowadays.

Another novelist who wrote for children was the Scotsman, George Macdonald (1824-1905). Success came to Macdonald with his novels of Scotch country life but his lasting fame rests on three stories which we hope you know well—THE PRINCESS AND THE GOBLIN, THE PRINCESS AND CURDIE and AT THE BACK OF THE NORTH WIND.

A contemporary of these last two authors was Dinah Maria Mulock Craik (1826-87), who is usually spoken of as Miss Mulock. Some critics, such as Henry James, have said that her work is very sentimental, but all of them agree on the kindliness and nobility shown in her books. Her best-known novel, JOHN HALIFAX, GENTLEMAN, was enormously popular. Among her successful stories for children are THE LITTLE LAME PRINCE and THE ADVENTURES OF A BROWNIE AS TOLD TO MY CHILD.

Margaret Oliphant Oliphant (1828-97) was a Scottish novelist. Her descriptions of small town life are sometimes excellent, as in SALEM CHAPEL. She was capable of handling irony with a light and delicate touch, as in MISS MARJORIBANKS. These two books are a part of her best-known work, THE CHRONICLES OF CARLINGFORD.

TRILBY, by George Du Maurier (1834-96), is written with great charm and is the best-known English novel about the life of artists in Paris. In part the enormous popularity of this novel was due to the melodramatic plot, in which the heroine is hypnotized by the villain, Svengali, under whose spell she can sing with unearthly beauty.

Sir Walter Besant (1836-1901) wrote a great many novels, for the most part very readable and widely popular. He was a warm-hearted man who worked hard to improve the lot of poor people, especially in

the great city of London. Some of his ideals of social betterment are shown in his novel ALL SORTS AND CONDITIONS OF MEN.

Ouida is the pen name of Louise de la Ramée (1839-1908), a writer of extravagantly colorful romances. UNDER TWO FLAGS is one of her best novels. Two of her stories widely read by young people are A DOG OF FLANDERS and THE NÜRNBERG STOVE.

The most famous novel written by Mrs. Humphry Ward (1851-1920) was ROBERT ELSMERE. In this book she embodied her idea that Christianity could—and must—shoulder the burden of the world's ills. She lived well into the twentieth century and she became an ardent suffragette.

Sir Hall Caine (1853-1931) used the Isle of Man as the background for many of his most well-known novels, notably THE DEEMSTER and THE CHRISTIAN.

Maria Corelli (1855-1924) was a writer of very fanciful and florid romances, among them BARABBAS and THE YOUNG DIANA.

Fiona Macleod is the pen name of the Scotsman William Sharp (1856-1905). He published some few novels under his own name, but he was at his happiest when he wrote as Fiona, who, he pretended, was a real woman. Fiona's Celtic tales and poems are full of haunting beauty.

Sir Henry Rider Haggard (1856-1925) wrote first-rate yarns of adventure and mystery. Among his best are SHE, KING SOLOMON'S MINES and MONTEZUMA'S DAUGHTER.

Another novelist famous for his novels of romantic adventure was Sir Anthony Hope Hawkins (1863-1933). He wrote under the name of Anthony Hope. Two of his most popular stories are THE PRISONER OF ZENDA and RUPERT OF HENTZAU, which were made into highly successful plays.

This account of the writing genius of the nineteenth century would be incomplete if it did not tell you something about four books that deeply interested the readers of their day. Indeed, their day is not yet over, for these books are still widely read and loved, and it may well be that this will always be so.

LORNA DOONE, by Richard Doddridge Blackmore (1825-1900), is one of the tenderest of love stories. The setting is the wild hill country of Exmoor, England, in the seventeenth century, and the story is based on legends of a band of outlaws named Doone.

THE CLOISTER AND THE HEARTH, by Charles Reade (1814-84), is a great historical romance by a great story-teller. Full of high courage and lofty idealism, this dramatic tale sustains a lifting quality to the end. It is the sort of thing from which portions may be read over and over again. This is equally true of LORNA DOONE. TOM BROWN'S SCHOOL DAYS is probably the finest of all the many books that have been written about school boys. Its author, Thomas Hughes (1822-96), vividly recalled his own school days at Rugby under the famous Dr. Arnold, and these memories live again in the entertaining adventures and high ideals of sportsmanship that have made this novel so dearly beloved.

Brown Brothers

When Lewis Carroll wrote ALICE IN WONDERLAND he was thinking of little Alice Liddell.

And nobody who has read the book need be told that ALICE IN WONDERLAND is a masterpiece of imagination and delicious nonsense. Its author was Charles Lutwidge Dodgson (1832-98), whose pen name was Lewis Carroll. He has been called a genius, and those who love his book can not think this praise too high. ALICE is a foundation book in every child's library; but grown-ups find pleasure in reading it, too.

So we close the literary page of the nineteenth century. Some of the literary forms common earlier were not much used; and some new forms, particularly the modern novel, took their place. Much of the literature of this period was stormy, and even bitter; and many writers became interested in social problems. But the times were stormy and bitter, too; and social problems were more pressing than ever before. It is a credit to these writers that they met that challenge.

By JOHN K. M. MCCAFFERY.

THE NEXT STORY OF LITERATURE IS ON PAGE 4103.

THE FACE NO MAN COULD LOOK ON

From The Age of Fable, *by* Thomas Bulfinch

Illustrated by Garth Williams

Once, in ancient Greece, there was born a child who was called Perseus. His grandfather Acrisius, alarmed by an oracle which had told him that his daughter's child would be the instrument of his death, caused the mother and child to be shut up in a chest and set adrift on the sea. The chest floated towards Seriphus, where it was found by a fisherman who conveyed the mother and infant to Polydectes, the king of the country,

by whom they were treated with kindness. When Perseus was grown up Polydectes sent him to attempt the conquest of Medusa, a terrible monster who had laid waste the country. She was once a beautiful maiden whose hair was her chief glory, but as she dared to vie in beauty with Minerva, the goddess deprived her of her charms and changed her beautiful ringlets into hissing serpents. She became a cruel monster of so frightful an aspect that no living thing could behold her without being turned into stone. All around the cavern where she dwelt might be seen the stony figures of men and animals which had chanced to catch a glimpse of her and had been petrified with the sight. Perseus, favored by Minerva and Mercury, the former of whom lent him her shield and the latter his winged shoes, approached Medusa while she slept and taking care not to look directly at her, but guided by her image reflected in the bright shield which he bore, he cut off her head and gave it to Minerva, who fixed it in the middle of her ægis, or shield.

After the slaughter of Medusa, Perseus, bearing with him the head of the Gorgon, flew far and wide, over land and sea. As night came on, he reached the western limit of the earth, where the sun goes down. Here he would gladly have rested until the morning.

Now this was the realm of King Atlas, whose bulk surpassed that of all other men. He was rich in flocks and herds and had no neighbor or rival to dispute his state. But his chief pride was in his gardens, whose fruit was of gold, hanging from golden branches, half hid with golden leaves. Perseus said to him, "I come as a guest. If you honor illustrious descent, I claim Jupiter for my father; if mighty deeds, I plead the conquest of the Gorgon. I seek rest and food."

But Atlas remembered that an ancient prophecy had warned him that a son of Jove should one day rob him of his golden apples. So he answered, "Begone!" And he attempted to thrust Perseus out. Perseus, finding the giant too strong for him, said, "Since you value my friendship so little, deign to accept a present;" and turning his face away, he held up the Gorgon's head.

Atlas, with all his bulk, was changed into stone. His head and hair became forests, his arms and his shoulders became cliffs, his head a summit, and his bones rocks. Each part increased in bulk till he became a mountain, and (such was the pleasure of the gods) heaven with all its stars rests upon his shoulders to this very day.

THE SEA-MONSTER

PERSEUS, continuing his flight, arrived at the country of the Æthiopians, of which Cepheus was king. Cassiopeia, his queen, proud of her beauty, had dared to compare herself to the Sea-Nymphs, which roused their indignation to such a degree that they sent a prodigious sea-monster to ravage the coast. To appease the deities, Cepheus was directed by the oracle to expose his daughter Andromeda to be devoured by the monster.

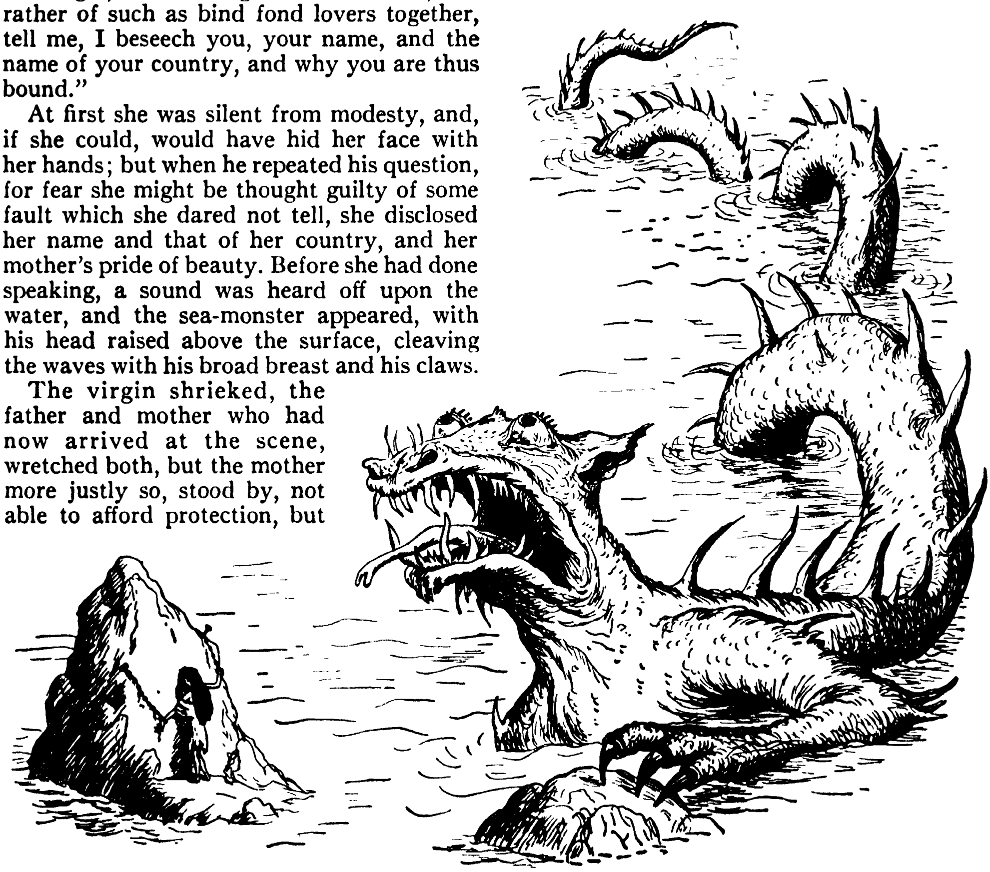
As Perseus looked down from his aerial height he beheld the virgin chained to a rock, and waiting the approach of the serpent. She was so pale and motionless that if it had not been for her flowing tears and her hair that moved in the breeze, he would have taken her for a marble statue. He was so startled at the sight that he almost forgot to wave his wings. As he hovered over her he said, "O virgin, undeserving of those chains, but rather of such as bind fond lovers together, tell me, I beseech you, your name, and the name of your country, and why you are thus bound."

At first she was silent from modesty, and, if she could, would have hid her face with her hands; but when he repeated his question, for fear she might be thought guilty of some fault which she dared not tell, she disclosed her name and that of her country, and her mother's pride of beauty. Before she had done speaking, a sound was heard off upon the water, and the sea-monster appeared, with his head raised above the surface, cleaving the waves with his broad breast and his claws.

The virgin shrieked, the father and mother who had now arrived at the scene, wretched both, but the mother more justly so, stood by, not able to afford protection, but only to pour forth lamentations and to embrace the victim.

Then spoke Perseus: "There will be time enough for tears; this hour is all we have for rescue. My rank as the son of Jove and my renown as the slayer of the Gorgon might make me acceptable as a suitor; but I will try to win her by services rendered, if the gods will only be propitious. If she be rescued by my valor, I demand that she be my reward." The parents consented (how could they hesitate?) and promised a royal dowry with her.

And now the monster was within the range of a stone thrown by a skillful slinger, when with a sudden bound the youth soared into the air. As an eagle, when from his lofty flight he sees a serpent basking in the sun, pounces upon him and seizes him by the neck to pre-



vent him from turning his head round and using his fangs, so the youth darted down upon the back of the monster and plunged his sword into its shoulder. Irritated by the wound, the monster raised himself into the air, then plunged into the depth; then, like a wild boar surrounded by a pack of barking dogs, turned swiftly from side to side, while the youth eluded its attacks by means of his wings. Wherever he could find a passage for his sword between the scales he made a wound, piercing now the side, now the flank, as it sloped toward the tail. The brute spouted from his nostrils water mixed with blood. The wings of the hero were wet with it, and he dared no longer trust to them. Alighting on a rock which rose above the waves, and holding on by a projecting fragment, as the monster floated near he gave him a death stroke. The people who had gathered on the shore shouted so that the hills reechoed with the sound. The parents, transported with joy, embraced their future son-in-law, calling him their deliverer and the savior of their house, and the virgin, both cause and reward of the contest, descended from the rock.

THE SHEPHERD-MAID and THE SWEEP

An old-fashioned oaken-wood cabinet, black with age and covered with fine old carving, once stood in a parlor; it was carved from top to bottom—roses, tulips and little stags' heads with long, branching antlers, peering forth from amid the curious scrolls and foliage surrounding them. In the centre panel of the cabinet was carved the full-length figure of a man. He was a most ridiculous figure; he had crooked legs, small horns on his forehead, and a long beard. The children of the house called him "the crooked-legged Field-Marshal-Major-General-Corporal-Sergeant."

There he stood, his eyes always fixed upon a table across the room, for on this table stood a pretty little porcelain Shepherdess. Her mantle was gathered gracefully round her and fastened with a red rose; her shoes and hat were gilt, her hand held a crook—oh, she was very charming! Close by her stood a little porcelain Chimney-sweep. His face was as fresh and rosy as a girl's, which was certainly a mistake, for it ought to have been black. His ladder in his hand, there he kept his station, close by the little Shepherdess; they had been placed together from the first, and had long ago plighted their troth.

Not far off stood a figure three times as large as the others; it was an old Chinese Mandarin, who could nod his head; he declared that he was grandfather to the little Shepherdess, and when the crooked-legged Field-Marshal-Major-General-Corporal-Sergeant made proposals to the little Shepherdess, he nodded his head in token of his assent.

"Now you will have a husband," said the old Mandarin. "You will be the wife of a Field-Marshal-Major-General-Corporal-Sergeant, of a man who has a whole cabinet full of beautiful silver, besides a store of no one knows what in the secret drawers."

"I will not go into that dismal cabinet!" declared the little Shepherdess. "I have heard that eleven porcelain ladies are already imprisoned there."

"Then you shall be the twelfth, and you will be in good company," rejoined the Mandarin. "This very night, when the old cabinet creaks, you shall have a wedding party, as sure as I am a Chinese Mandarin." Whereupon he nodded his head and fell asleep.

But the little Shepherdess wept, and turned to the beloved of her heart, the porcelain Chimney-sweep.

"I believe I must ask you," said she; "to go out with me into the wide world, for here we cannot stay."

"I will do everything you wish," replied

the little Chimney-sweep. "Let us go at once. I think I can support you by my profession."

"If we could only get off the table!" sighed she. "I shall never be happy till we are away."

And he comforted her, and showed her how to set her little foot on the carved edges and delicate foliage twining around the leg of the table, till at last they reached the floor. But turning to look back, they saw everything in a great commotion; the old Mandarin had awakened and was rocking himself to and fro with rage.

"Oh, just see the old Mandarin!" cried the little Shepherdess; and down she fell on her porcelain knees in the greatest distress.

"Have you the courage to go with me into the wide world?" asked the Chimney-sweep taking her hand.

"I have," replied she.

And the Chimney-sweep looked keenly at her, then led her to the stove.

"Oh, how black it looks!" sighed the shepherd maid. However, she went on with him, through the flues and the tunnel, where it was pitch-dark.

"Now we are in the chimney," he remarked; "and look, what a lovely star shines above us!"

And there was actually a star in the sky, shining right down upon them as if to show them the way. They crawled and crept till they reached the top of the chimney, where they sat down to rest for a while.

Heaven with all its stars was above them, and the town with all its roofs lay beneath them; the wide, wide world surrounded them. The poor Shepherdess had never imagined all this; she put her little head on the Chimney-sweep's arm and wept so that the gilding broke off from her waistband.

"This I cannot endure!" she exclaimed. "The world is all too large. Oh, that I were once more upon the little table! I shall never be happy till I am there again. I have followed you out into the wide world, surely you will follow me home again, if you love me."

Then the Chimney-sweep talked very sensibly to her, reminding her of the old Chinese Mandarin and the crooked-legged Field-Marshal-Major-General-Corporal-Sergeant; but she wept so bitterly, and kissed her little Chimney-sweep so fondly, that at last he yielded to her request. So with great difficulty they crawled back down the chimney, and at length found themselves once more in the dark stove.

Everything was quite still. They peeped out. Alas! on the ground lay the old Chinese Mandarin; in attempting to follow the runaways, he had fallen down off the table, and had broken into three pieces.

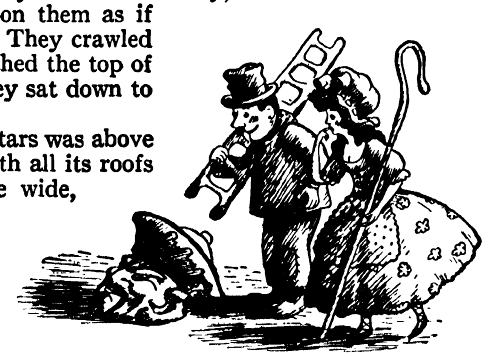
"Oh, how shocking!" exclaimed the little Shepherdess. "Poor old grandfather is broken in pieces, and we are the cause of this dreadful accident."

"He can be put together again," replied the Chimney-sweep. "If they glue his back together, and put a strong rivet in his neck, then he will be as good as new again."

"Do you really think so?" she asked. And then they climbed up the table to their old places.

No one welcomed them back because the fall of the Mandarin had shocked everyone into silence.

The old Chinese Mandarin was put together; the family had his back glued and his neck riveted; he was as good as new, but he could no longer nod his head.



"You have certainly grown very proud since you broke in pieces," remarked the crooked-legged Field-Marshal-Major-General-Corporal-Sergeant, "but I must say, for my part, I am unable to see that there is anything to be proud of. Am I to have the Shepherdess or am I not? Just answer me that!"

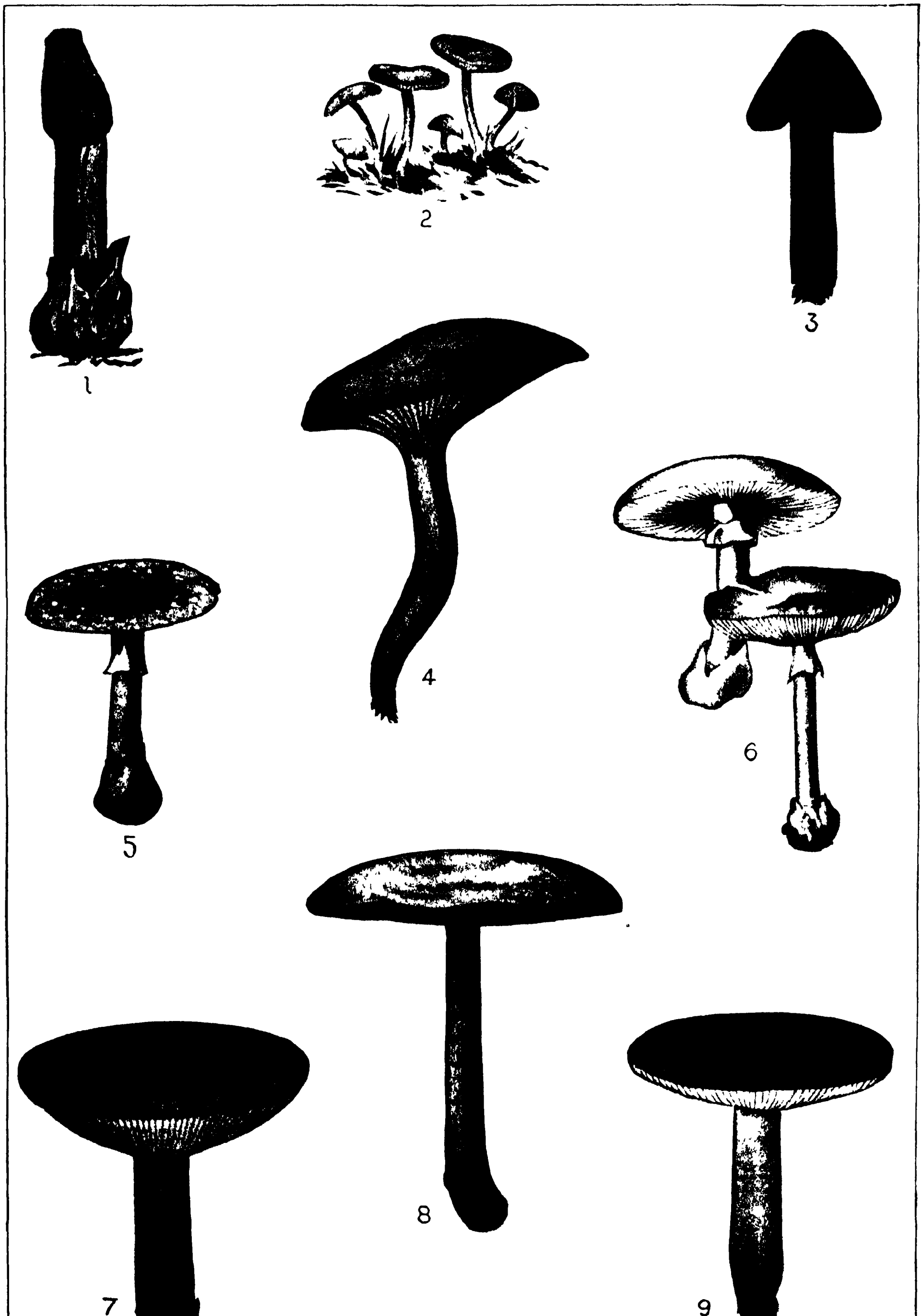
And the Chimney-sweep and the little Shepherdess both looked imploringly at the old Mandarin; they were so afraid lest he should nod his head. But nod he could not; and it was disagreeable to him to confess to a stranger that he had a rivet in his neck, so he only stared stiffly back at the crooked-legged Field-Marshal-Major-General-Corporal-Sergeant. And the young porcelain people always remained together. They blessed the grandfather's rivet, and loved each other for the rest of their lives.

THE NEXT STORIES ARE ON PAGE 4136.

EDIBLE AMERICAN MUSHROOMS

1. Beefsteak or Liver Fungus (*Fistulina hepatica*). 2. Meadow Toadstool (*Lactarius distans*). 3. Morel (*Morchella esculenta*). 4. Chantarelle (*Cantharellus*). 5. Coral Fungus (*Clavaria rugosa*). 6. Fairy-ring Mushrooms (*Agaricus*). 7. Cultivated Mushrooms; young and old. 8. Forest Mushroom (*Agaricus silvacola*). 9. Edible Boletus; young. 10. Ochre-gilled Russula (*Russula ochraphylla*). 11. Velvety Clitocybe (*Clitocybe velutipes*). 12. Bear's-head Mushroom (*Hydnum caput-ursi*). 13. Oyster Mushroom (*Agaricus ostreatus*).

POISONOUS OR UNWHOLESOME AMERICAN FUNGI



1. Stinkhorn or Fetid Wood-witch (Phallus impudicus)
2. Poisonous Fairy-ring, Agaric, (Marasmius urens)
3. Red-juice Mushroom (Hygrophorus conicus)
4. Deceiving Clytocybe (Clytocybe illudens)
5. Fly Mushroom (Amanita muscaria)
6. Death-cup, or Spring Mushroom (Amanita phalloides); two varieties
7. Red-milk Mushroom (Lactarius rufus)
8. Fiery Boletus (Boletus piperatus)
9. Emetic Mushroom (Russula emetica)

Where mushrooms may be found in the spring.

MUSHROOMS, EDIBLE AND POISONOUS

VERY often in early summer any one of you can look out over some broad, gently rolling lawn, or else over a close-cropped pasture, and see what at the first glance seem like the ends of tiny eggs peeping through the short grass. A second's thought will tell you what they are, and perhaps your father may tell you of his boyhood in the country, when he roamed the pastures and the fields and saw these same "fairy rings" of "toadstools," with the brighter green circle of the grass surrounding a faded patch within, and he may tell you some stories about them. Only the other day, my boy, an observant lad, called my attention to a beautiful ring on a lawn as we passed quickly by in a car.

Perhaps you have pretended, as children have for centuries, that nimble elves and goblins have danced the night long within the magic ring that so mysteriously has sprung into being overnight, and that they wore the grass out with their pointed slippers. Probably you've called them toadstools and thought them poisonous. If you found them in the open pastures or fields, they are not often harmful. Those that grow in woods are not safe to eat. So be sure not to experiment until you learn more about mushrooms and their habits and appearance.

Many people call all fleshy fungi toadstools; but it is not certain that toads ever use these queer growths for resting-places, and it is quite certain that the right name for them is mushrooms, which, some think, is derived from two Welsh words meaning "field" and "knob." Others think that the word has something to do with moss. Some mushrooms are edible, and some are very dangerous to eat. One must learn something about them before eating them.

From the first century, and perhaps earlier times, we have records of mushrooms as an article of food, and abundant fossils of mushrooms in the vast coal and peat deposits show that years ago, when this old, old world of ours was a very different place, the gentle pushing of these fragile growths managed, as to-day, to break a way through the ground, even lifting hard clods and pushing aside stones.

Very early historians and writers mention mushrooms. One Roman historian tells of "fine knives and razors of amber and other dishes of silver," which the cooks used in preparing these delicacies for the epicures of his time. Another old writer, however, thought them not at all wholesome. "For every hue they display," he writes, "there is a pain to correspond to it." Possibly those

employed by wicked persons of that age to prepare deadly concoctions used the poisonous mushrooms, and Nero, cruel monarch of Rome, fed a large party of invited guests on mushrooms he knew would cause their death.

Most of the inhabitants of European and Asiatic countries scour the fields and woods for mushrooms, and as many of them seldom have meat, these rapid-growth fungi take its place. China imports mushrooms from Japan and other Pacific islands to supply the demand, and even has officially issued for free distribution "anti-famine" books about mushrooms and their food values. In Southern Europe dogs and pigs are trained to hunt for one sort called truffles, which grow under the fallen leaves of the vast forests; and as the animals, too, like to eat them, the men have to scramble to gather them first as they are uncovered by the sharp little hoofs and claws.

THE "VEGETABLE MEAT" SO PLENTIFUL AND CHEAP

Truffles have not yet been found in the United States, but Americans are beginning to realize that right at their door is a substitute, in many varieties of mushrooms, for the meat that is constantly growing dearer. Since the flavor of different varieties resembles oysters, beefsteak, chicken, sweetbreads and fish, it is no wonder that they are often called "vegetable meat." Of course they have not so much food value, pound for pound, as meat, but when they can be had for nothing they should not be neglected.

The odor of mushrooms sometimes resembles that of other plants or fruit, such as garlic, apricots, radishes, fresh meal or anise. In proportion to the number of varieties, those known as dangerous are no more than among flowering plants. To Dr. M. A. Curtis, of North Carolina, belongs the credit of the first systematic classification and study of mushrooms in North America, and already several hundred varieties are listed as perfectly safe.

MUSHROOMS AND OTHER FUNGI AND HOW THEY GROW

Mushrooms are a division of fungi. Mildew, mold, rust, smut in grain, all are forms of fungi. The fleshy sort that have queer shapes like umbrellas, nests, hoofs, shells, clubs, spheres, hemispheres, cones, bears' heads and ears, although flowerless, are profuse and well known. They spring up overnight from April to late fall, and are the fruit of a running white mold-like growth spreading through dead leaves, earth or decaying wood. After a rain or other favorable conditions a certain point in this mass of fibres suddenly begins to grow. In a few hours it has pushed up out of the ground like an egg, and in another hour or two the outer envelope, or veil, is broken, sometimes leaving remnants on the cap and sometimes showing a ring of itself under the cap on the stem.

THE WONDERFUL SPORES OF THE MUSHROOMS

Edible fungi are surprisingly different in appearance, ranging from coral-shapes or fluted vases to the usual umbrella form. One has been known to grow to weigh thirty pounds. They have no seeds, but produce "spores," which are as fine as dust and, singly, are invisible to the naked eye. The dust-brown spores of the puff-balls are inside; the spores of the Morel, which is unlike any other fungus and is always edible, are in delicate sacs on the cap which finally burst at the tip; those of the gill-bearing mushrooms shake down from the fan-like drapery attached to the under-side of the cap, and those of the cushioned sort, whose surface is evenly punctured with very numerous little holes as if pricked with a pin, shake themselves out as pepper comes from the shaker.

One can "take a picture" by nature's own developer of any of the last two sorts, in natural colors, too, if he will cut off the stems of several mushrooms close to the cap, and place them, gills or cushion down, upon sheets of white or colored paper. As some of the spores are white, it is well to use both kinds of paper for each specimen until one becomes acquainted with the spores. Cover with a glass dish, or, at least, be sure that no draft of air disturbs mushrooms or papers, and in a few hours, or in the morning if you leave them overnight, you will have an exact reproduction of the mushrooms from their own active spores. Try it; it is one of the most interesting of things to do. Those that have colored spores reproduce each delicate shade, while the white ones are as soft as snow.

Mushrooms have to live on food manufactured by other plants, vegetables or trees, and their spores are quite particular where they shall start their own life as mushrooms. Some baby spores grow only if they alight upon the spines of a

dead chestnut burr; others like sawdust, oak leaves, dark coal-mines or decaying animal substance of various kinds. It has been estimated that from one puffball, so aptly called an "elfin teepee" with its thread of invisible spores rising like smoke, come at least ten million spores, and they must fall on exactly the right spot before setting up their own lives. Old-fashioned doctors used these spores to staunch fresh wounds.

FOOD WHICH IS FOUND IN FIELDS AND WOODS

Mushrooms are greedy eaters; they grow rapidly and decay soon. Some sorts respond to artificial culture through "spawn," which is the thread-like substance which goes through muck as yeast does through unbaked bread, and many people make comfortable livings by raising them. But they are so abundant in the United States that almost anyone having access to the open may gather during the summer and fall "an hundred weight of wholesome food rotting under the trees," if he knows the right mushrooms to pick. But, as a whole, they do not bear transplanting, nor respond to cultivation. Instead, they stand on their one leg, quite independent of anyone.

Because some mushrooms are delicious eating and others are extremely poisonous, one must learn a great deal about them before venturing to cook and eat. He must become acquainted with their manner of growth, their color, odor and general appearance. The prejudice against mushrooms is needlessly sweeping, but careful instruction will teach a few, at least, of the edible sorts, and the deadly varieties are easily recognized. Each must be learned as we learn to tell the difference between a blue jay and a robin. However, there is one, and only one, infallible sign that a mushroom is poisonous—the presence of the "cup," or socket, from which the stem grows. It is always below the surface of the ground. Look for it. Any mushroom that turns blue when cut or bruised should be let alone. Mushrooms having worms and those that are decayed have an unpleasant smell, and, again, if you taste a small bit, and the mushroom stings, is bitter or otherwise unpleasant, or exudes a milky juice on being cut or wounded, be sure to let it alone. Some mushrooms which have one or more of these qualities may not be poisonous, but only an expert can decide. Shun as poison a brilliant cap of yellow, orange or even scarlet, studded with white or grayish spots, for this produces the deadly "fly-poison." Czar Alexis died from eating this sort, as did several noted French *savants*.

MUSHROOMS WHICH MAY BE USED AS RAZOR STROPS

Some people say that any mushroom that grows on a tree is poisonous; but those growing *sidewise* from position, with dirty white gills and a light brown or buff top, are safe, according to eminent authorities. From some of these flesh-like growths, however, comes tinder, punk and touchwood, and the phosphorescence that makes old wood gleam in the dark is decaying fungi. One lovely white mushroom springing up overnight contains the most deadly vegetable poison known, and one growing on the birch tree can be used as a razor strop!

Aside from the deaths that occur from careless handling of unknown poisonous mushrooms some people have died because they gathered them when decayed, or they did not cook them *at once*. As mushrooms are so much like animal food, they have the same tendency to decay, and who would think of eating putrid meat? In gathering, be sure to look beneath the surface of the ground for the telltale "cup"; use a sharp knife, cut an inch or two from the cup so no dirt will adhere to the mushroom, and before putting in your basket it is better to wrap each specimen in tissue-paper which you have provided. It keeps them unbruised, and if you have taken one that is not quite safe, it will not hurt the others.

SEVEN KINDS OF MUSHROOMS THAT ARE SAFE EATING

Out of the many mushrooms that are safe we have pictured thirteen to help you to identify some of those you may find; and that you may make no mistake, we also show nine that are either poisonous or unpleasant to eat. Note the difference between the Fairy-ring (number 6 of the edible varieties) mushroom that grows in the open and its wicked counterpart (number 2 of the poisonous) which slinks in the shade as if afraid to come to the light. And be sure not to confuse number 8 (edible) with the most deadly of all poisonous mushrooms, the lovely Amanita, with its death-cup hidden beneath the ground's surface (number 6, poisonous). Look for that cup, always!

Besides the pictures we shall describe six or seven, and after studying the illustrations and text you can gather a good meal outdoors.

The Meadow mushroom is the best known and most widely found. It is smooth or slightly rough, according to its age, and is creamy white or tawny. The color of its gills is most important. If we break away the veil in an unopened specimen we find the gills pallid pink. As the growth advances they become decidedly pinkish, changing to brownish black, and they are of unequal lengths. The stem is creamy white and solid, and always shows the remains of the veil in a frill or ring under the cap.

The Pasture mushroom is egg-shaped, expanding into a parasol sometimes seven inches across, with the apex raised in a marked degree. It is pale buff, spotted with shaggy patches; gills at first almost white, crowded, finally becoming like the cap in color. The stem is tall, slender, streaked and speckled with brown, encircled with a loose ring, hollow and growing from a fibrous bulb, having no sign of the fatal cup that is a never failing sign of poison. This mushroom has been called the Nut mushroom on account of its flavor, and dries naturally while standing in the pastures. It is also fragrant.

Puffballs are edible, although joyous school children usually think they are made to kick or to pinch so as to make the smoke fly. Yet, in their white stage they make very good eating, but be sure that you are not picking the deadly "cup" sort, for in its earlier stages that dangerous mushroom is apt to look like the innocent puffball. But, remember, the one is below ground, while puffballs are above. Once warned, twice armed! Be sure to open each specimen and be sure to look for the cup before giving your treasures to be cooked.

Green is a rare color among mushrooms, but that of the Green Russula is not the bright green of grass: rather it is a metallic or grayish green. These mushrooms are found in hardwood groves or their edges, and are as sweet as a chestnut. Their cap is slightly hollow and becomes broken at the fluted edge of the gills. The creamy white of the gills has the appearance of network; they are thick, very brittle and of equal length. The stem is solid and creamy white. This sort also has purple and reddish caps (number 10, edible).

When in late September you come upon what seems a strange nest of goose eggs, their summits spotted with brown, you may know you have found another "safe" mushroom. Nothing else looks like them. As this sort grows in dense masses, you can get a whole dinner for the family right there. These mushrooms are called Shaggy-manes because of a fancied resemblance to a wig, and should be gathered while the concealed, crowded and equal-lengthed gills are either white or pink; otherwise they are unwholesome, and they finally melt away into an inky mass.

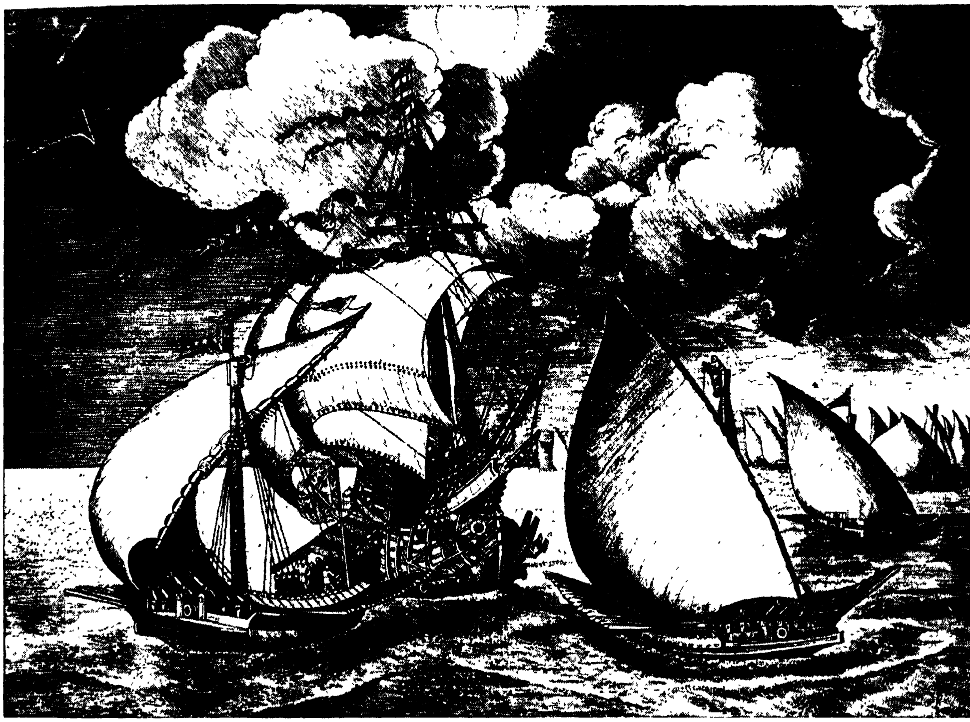
The edible Tube mushroom has a cushionlike, moist cap which is light brown or darkish red. The surface of the cap is dull and as smooth as a kid glove, and the stout stem is a pale brown, generally with a fine raised network of pink lines near the cap. The flesh of the light brown ones is white or yellowish and does not change color when broken. When young they are peculiarly nutty to the taste. They can be found during July and August.

One dark red variety closely resembles beefsteak in color, general appearance and flavor. This mushroom can never be mistaken, as it grows with its very short stem on stumps and trunks of oak or chestnut. One has been found weighing thirty pounds, and provided a hearty meal for several men after it was sliced in sections and broiled over live coals. The veins of darker red running through the pinky flesh of the under tube surface, combined with the clammy moistness of the dark red cap, make its name of Beefsteak mushroom most apt. There is also a yellow mushroom, *Polyporus sulphureus*, which grows in the same way. It tastes like lobster and is delicious.

Mushrooms will amply repay ardent study. Look, compare, assort, "photograph" their spores; be careful, and it will not be long before you can add to the family larder by your pleasant rambles through the fields and woods as well as to your fund of knowledge and personal happiness.

Get the illustrated bulletins issued by the Government and choose first those fungi which it is impossible to confuse with any of the dangerous varieties.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 4019.



The Metropolitan Museum of Art

A heavily armed naval vessel and some fighting galleys sail into battle. The oars of the galleys resemble fins.

THE REIGN OF WOODEN SHIPS

A LOG will float on water. It will float even with quite a heavy weight upon it. That simple fact is the basis of the boat-building industry that has gone on for many thousands of years. The earliest "boats" were rafts of logs lashed together. Two logs lashed together is called a catamaran, and is still used by natives of some of the South Pacific islands. Rafts of many logs were used for ferrying across rivers; and along the coast of Peru, great rafts of light balsa wood, 70 feet long and 20 feet wide, equipped with sails and oars, are today used in coastwise trade.

These are not properly vessels. The canoe is the earliest type of true vessel for navigating water. It may be called the ancestor of the ships that sail the oceans and seas of the world today. In the course of many thousands of years, as men became more skillful, the canoe was made larger and larger, and became what we call a boat, and it in turn developed into the ship.

The earliest form of canoe was the dugout which could be made wherever suitable trees grew. It was simply a log hollowed out. War canoes were very large. One made by the Indians of Vancouver Island, where the big trees grow, was 63 feet long, 8 feet wide and about 5 feet deep. Many varieties of canoes are made with a wooden framework covered with hides sewn together, or covered with bark or thin wood stitched or glued together with waterproof gums or pitch. In the South Pacific islands canoes of great size are made to carry more than 100 tons. We might even call them small ships.

Canoes are propelled and guided with paddles, and sails are often used. The use of sails is of ancient origin. Anyone paddling a canoe or rowing a boat in a strong wind

knows that it is easier to go with the wind than against it. And men learned to make the most of wind power by using sails to catch the breeze, and thus riding before it.

These various craft were in use all over the world by primitive people, and most of the different kinds are still used to some extent. There came a time, though, when some countries advanced in civilization and required larger and stouter boats for water-borne freight and passengers, and for warships. Men also learned how to make and use metal tools, by which planks and timbers could be cut from trees. The art of weaving grew up so that sails could be made from various fibers of flax, hemp and the like. Even silk was used on boats of kings and the very wealthy. In China and the Far East woven matting of bamboo and other fibers was used for sails, and is still used. Until iron became fairly plentiful some hundreds of years ago, ships had the frame and planks held together by wooden pins, called tree-pins. These were dry hardwood pins which were driven in holes, and when they became wet they would swell and make a tight fastening. In very stormy weather great ropes were passed around the ship to help hold it together.

Stone Age shipbuilders hollow out logs for boats.

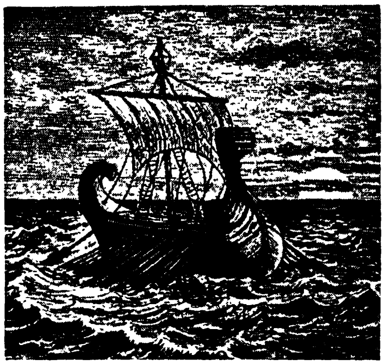
The earliest historical knowledge we have of boat and ship building comes from Egypt. It is now believed that the Egyptians were boat-builders as early as 6000 B.C.; that is, about 8,000 years ago. Wall-pictures and sculptures, discovered in tombs and remains of temples, show clearly the types of vessels. In addition, models of boats have been found in tombs. The dwellers of the Nile Valley believed the souls of the dead needed such boats to sail the waters of the next world. These little model boats have carved masts, oars and sails.

A drawing of a very early sailing boat

The Metropolitan Museum of Art

Our picture shows a model of a Nile River boat used by the Egyptians about 5000 B.C. A square sail was used when the wind was favorable; paddles, when it was not. In the stern was a small cabin. Notice the steering oar.

shows a mast and sail set far forward. Aft is a small cabin. Later boats were decked in. When the sail was not in use the boat was propelled by paddles. Later, oars came into use as boats became larger, for it was discovered that oars gave much more power than paddles, and in boats with high sides the oars could be worked through holes in the side. For a rudder a long sweep or paddle was mounted at the stern.


A Greek merchant ship for coastwise trade, broad-beamed, with a square sail.

The introduction of oar-power marked the growing difference between warships and merchant ships. Warships required speed and quick handling, especially in battle, and could not depend upon the wind with the kind of sails and rigging ships had then. More than a hundred oarsmen were used on larger warships. These men took up room needed for cargo and passengers on merchant ships; hence the latter depended more on sails and used oars as little as possible.

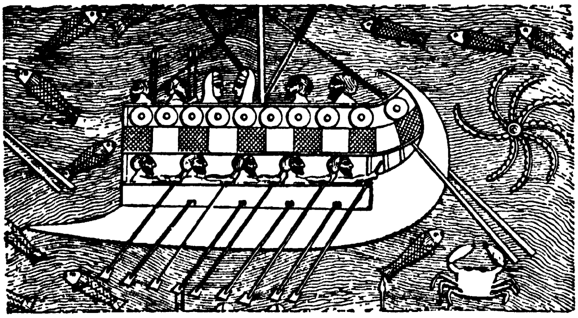
Originally the Egyptians used their boats for navigating the Nile; but in the course of centuries they ventured out on the Mediterranean with larger ships. By 1600 B.C. they were the leading seafaring people on that sea. This was the time of the reign of Queen Hatshepsut, one of ancient Egypt's most famous and ablest rulers. She organized a great fleet to go on a voyage to the rich and fabled land of Puoni (or Punt). It is believed that this country existed where Ethiopia and Somaliland are today. The expedition sailed from the Nile through a canal which then existed through the Wadi Tumilat to the upper end of the Red Sea, and down the Red Sea to the Indian Ocean and along the coast of Africa to Puoni.

The expedition was gone three years, and it brought back with it such riches as the Egyptians had never seen before: gold, silver, ivory, heaps of incense resin, frankincense, rare wood and other things of great value. What makes this voyage so remarkable is that the Red Sea is the most dangerous and difficult sea in the world to navigate by sail and oars. It has contrary winds, dangerous currents, is lined with hidden reefs and has 1,200 miles of waterless shores with no harbors. The heat is very intense, and until the age of steam the Red Sea was known as the "graveyard" of numerous expeditions seeking passage to the riches of the Orient.

After the reign of Queen Hatshepsut, the Egyptians lost their great spirit of enterprise; and a new people of seafarers arose at the eastern end of the Mediterranean. These were the Phoenicians, who built their cities along the narrow coastal shore between the sea and the Lebanon Mountains. They were a great industrial and trading people and prospered by foreign trade. We know of their ships and industries from the ancient Greeks, and from the account in the Bible of the building of Solomon's Temple about 1000 B.C., and from the account of their ships and products given by Ezekiel about 600 B.C. They dared the terrors of the Red Sea, and


Brown Brothers

A boat made by lashing planks together. The development of this kind of construction made possible an increase in the size of vessels.



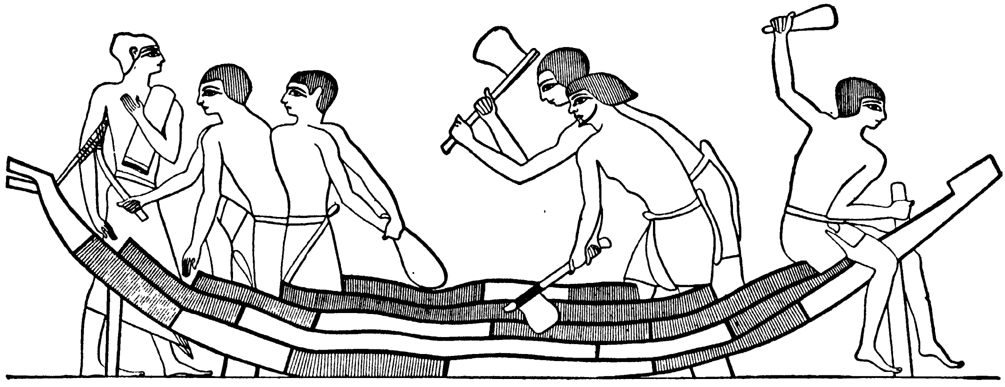
In order to get more power without increasing the length of their ships, the Phoenicians used two rows of oarsmen.

their ships visited India and East Africa, and there is evidence that they circumnavigated (sailed all the way around) Africa. They sailed regularly out into the Atlantic, and traded for tin with the natives of southern Britain, the region that is now Cornwall. They founded Carthage in North Africa, the city which, hundreds of years later, became the great naval rival of Rome. The Phoenicians improved on the Egyptian ships by making them larger and stronger. They had a fine supply of wood in the Lebanon Mountains, including the famous cedars of Lebanon which they used for masts. They equipped their ships with two rows, or banks, of oars on each side; the sides were higher, and one bank of oarsmen sat above the other. The bow of the ship was armed with a ram for crushing in the side of an enemy ship. The hulls of these ships were long, narrow, straight and flat-bottomed.

When the power of Phoenicia was at its height, a new seafaring people, the ancient Greeks, began to rival them. We have much better knowledge of the Greek ships, and of the later Roman ships, through their histories and other literature that has come down to us. The Phoenicians invented the bireme, or warship with two banks of oars; but the Greeks as early as 700 B.C. invented the trireme, which had three banks of oars. The trireme became the principal warship of the Greeks. In most respects the Greek vessels resembled the warships of the Phoenicians. Some had as many as 170 oarsmen. The sail was very little used. The Greek merchant ships were much larger and broader. They were double-ended and flat-bottomed, with large square sails on which they depended rather than on oars. They were as large as the average merchant ship of the seventeenth century, and accounts in history tell of the larger ones carrying 600 people.

Through their navies the Greeks became masters of the eastern Mediterranean. This was after the famous sea fight at Salamis, in 480 B.C., when 378 Greek triremes defeated with great loss the Persian fleet of Xerxes consisting of 1,200 ships. The Greeks discovered means of navigating the strong tides and cross-currents of the Dardanelles, and opened up the shores of the Black Sea to trade and colonization. It is said that they knew how to tack with sailing vessels; that is, to sail against the wind.

After the time of Alexander the Great, about 300 B.C., the power of Greece began to decline. Carthage and Rome became rivals for control of the Mediterranean; and before the beginning of the Christian Era, Rome won out and became mistress of the Western world. The Mediterranean was a Roman sea for many centuries. The Romans de-



The Egyptians were building boats almost 8,000 years ago. The shipbuilding scene above was found in an ancient tomb.

veloped larger warships similar to the Greek trireme, but with more banks of oars. For a while they used four, five, six and even more banks of oars, with increasingly higher sides to the ships. In actual battle these ships with many banks of oars proved to be very vulnerable, as small enemy biremes could dash in and sweep along the side of a big ship, crushing the oars on that side, making the ship helpless and putting it out of action. After this venture in warships of many banks, the general practice of the Romans was to use biremes and even ships with one bank of oars, which were much swifter and more easy to handle.

An artist of the Middle Ages made this fanciful illustration of Noah's Ark, the most famous ship in Holy Writ. This is the landing scene.

The merchant ships of ancient Rome were built even larger. A typical grain ship was about 180 feet long, 45 feet wide and 43 feet deep. Still larger ships carried huge blocks of marble and obelisks across the Mediterranean to Italy. The ship in which Saint Paul was wrecked on his way to Rome carried 276 people besides the cargo. These ships had three masts, with square sails, and a topsail on the mainmast.

For more than a thousand years after the decline of the Roman Empire there were few important developments in shipbuilding. During the Middle Ages the oar-driven warship, generally known as the galley, had one important improvement. This was the use of the long oar which was manned by more than one man. On all the warships up to the time of this improvement, the practice had been to have one man to each oar; and the oars were 12 to 16 feet long. The oars that came into use in the Middle Ages were from 30 to 50 feet long, and had from 2 to 6 or 7 men per oar. This reduced the number of oars greatly and made the timing of the stroke simpler than when more oars were used.

Some of the early Greek and Scandinavian oarsmen were freemen and warriors, but the general practice in all ages, from the time of the ancient Egyptians down to the seventeenth century, was to use galley slaves for oarsmen. They were slaves, war prisoners, criminals or political offenders. Above the oarsmen, who were chained to the oars, was an overseer with a long whip, who timed the stroke and used the whip to drive the men to greater effort. To be condemned to the galleys was next to being condemned to death.

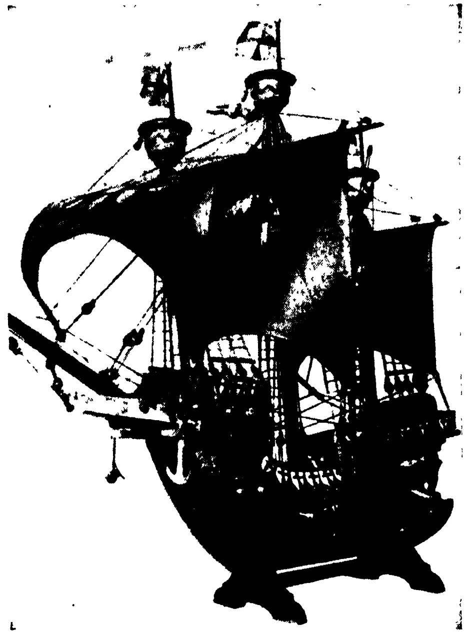
The earliest information of the ships and the seafaring peoples near the North Sea and the British Isles comes to us from the period following the Roman conquest of Gaul (France) and Britain (England).

Some of the tribes had made considerable progress in the art of shipbuilding. The Veneti of north Gaul had stout oaken ships quite as seaworthy as the Roman ships. Their ships were high in the bow and stern, and the sails were of leather. Oars were used only for steering.

The most notable of the seafaring people of the northern seas were the Norsemen, or Vikings. They had seagoing vessels of excellent type, long and narrow, high in the bow and stern, and propelled by sails and oars. The sizes ranged from ships with 32 oars to those with 64 oars and a crew of 240 men. The famous dragon-boats were still larger. Remains of one of the smaller vessels, for 32 oars, discovered in a burial mound in Norway, had a length of 78 feet, breadth of 16 feet and depth of about 6 feet. From this we get a good idea of the pro-

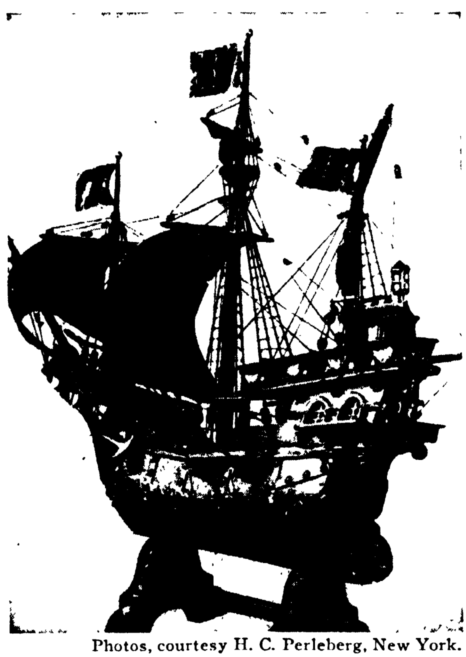
A PAGE OF OLD-TIME VESSELS

This is a model of a Roman man-of-war. From the ninth to the fifteenth centuries A.D. this type of ship was common in the Mediterranean.



In this Norman vessel of the time of the early Crusades there are resemblances to the Viking ships; for instance, in the shields and sails.

Here is a model of the ship that discovered a new world—the Santa Maria, in which Christopher Columbus crossed the Atlantic in 1492.



Photos, courtesy H. C. Perleberg, New York.

From the fourteenth to the sixteenth centuries the Dutch sailors made themselves feared on the seas. Our picture shows a model of a Dutch ship.

portions of these vessels. The Vikings were not only pirates, but were also explorers, and invaders and colonizers of the lands of northern Europe, and even around into the Mediterranean. They raided the coasts of the British Isles for nearly a thousand years, and in the tenth century A.D. they sailed out into the Atlantic and colonized Iceland and Greenland and touched the coast of North America.

Most of the development in these early times in the north of Europe seems to have been in warships driven by oars. We learn that Alfred the Great of England (848—about 900) built ships twice as long as the ships of the Danes who were attacking England.

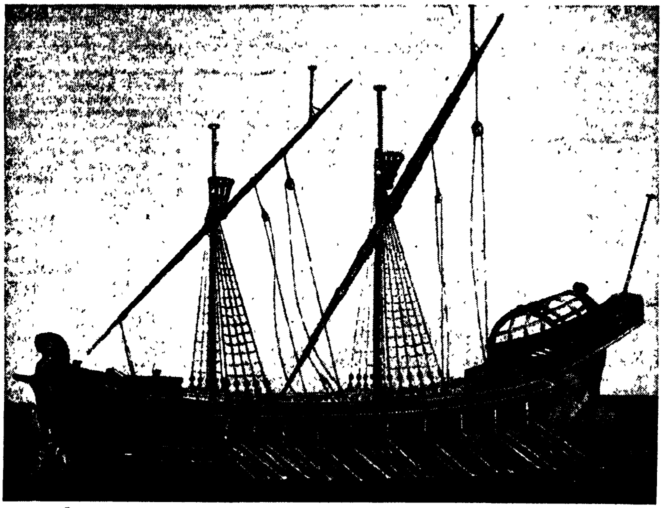
It was after the Crusades, which ended in the thirteenth century, that the sailing vessel for all purposes had its beginning. The English Crusaders that sailed to the Mediterranean came in contact with a tall-sided vessel with three masts, called a carack. This was a real ship, not dependent on oars. Before this the rudder had been invented in place of the large steering oars at the stern. This, with more sails and masts and more skill in using sails and rudder, made the sailing vessel easier to handle.

The art of tacking is said to have been known to the Greeks and other peoples, but it was brought to a higher development by the sailors of northern Europe. The modern sailing ship, merchant or warship, was not a development of the oar-driven galley, but is said to have been developed from the fishing and whaling ships common to the waters of Europe. The fisher-sailormen from necessity worked out a method of handling their boats by sails alone. By skill in setting their sail and in the use of the rudder, they could sail at an angle into the wind, and by tacking they gave sailing vessels almost complete control of the wind.

In England Henry V (1387-1422) built great ships of various types, some of which were 1,000-tons burden. The list of his fleet has no galleys in it. It is possible that the sailing vessel had come into use as a warship by that time, or before. In the meantime, the Spanish and Portuguese had developed a ship called a caravel, in which they sailed the oceans and made their discoveries. The caravel Santa Maria, the flagship of Columbus' fleet, was only 128 feet long and 26 feet beam, and carried a crew of 52 men.

The Bettmann Archive

Sailing ships of the late fifteenth century. Vessels which did not depend on oars at all became common at this time.



A fighting galley used in the Battle of Lepanto, October 7, 1571. It is a trireme, that is, it has three banks of oars.

ish and Portuguese and Venetian caracks that were used as merchant ships were of 1,600 tons burden, and 164 feet long. The French used most skill in building their ships, and led all others in the seventeenth and eighteenth centuries in speed and size; but of all the seafaring nations of the time, the English generally excelled in seamanship. The crews of their merchant ships and warships were recruited from the seafaring folk who manned the thousands of fishing boats and whaling ships of England. These men lived by following the sea, and were as skilled as the Vikings had been in sailing the stormy seas of northern Europe. This may account to a large extent for the ability of English warships and armed merchant ships to outmaneuver and outfight the larger and more heavily armed opponents of those times. Most other European sailors were less skillful.

The discovery and use of gunpowder brought about the arming of seagoing vessels with cannon as early as the year 1370. This brought about a change in construction in warships, and at the time of the defeat of

The vessels of Vasco da Gama that sailed around the Cape of Good Hope, were about the same size. The ship of John Cabot in which he discovered Newfoundland was still smaller, having a crew of only 18 men. Henry Hudson's ship, the Half Moon, in which he crossed the Atlantic and discovered what is now New York Bay and explored the Hudson River to the location of Albany, was less than 100-tons burden. The size of the Mayflower, that planted the first English colony in New England, was given as 100 tons. These were only little ships of exploring and colonizing ventures that did not have money enough to secure better vessels.

Naval ships and merchant ships continued to increase in size and number during the reigns of Henry VIII and Elizabeth of England. The largest of the warships was of 1,500 tons and had four masts. The Span-

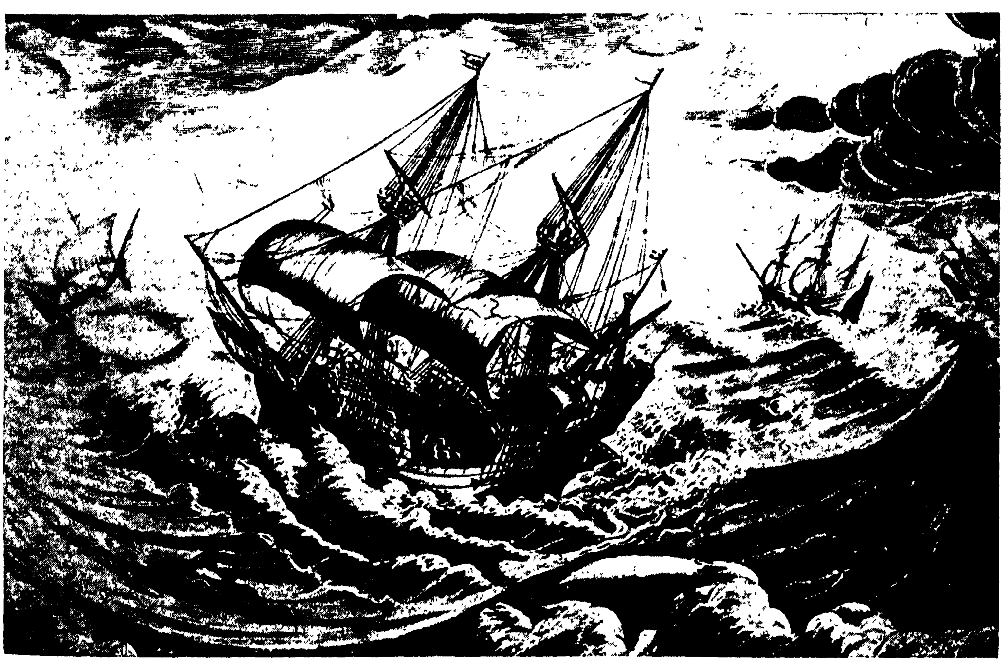
England began to rival Spain and Portugal in merchant shipping during the sixteenth and seventeenth centuries, when many large galleons like the one above sailed the seas. Such ships often had three or four decks, and were used for both war and commerce.

the great Spanish Armada, in 1588, by the English, the larger warships had as many as 55 cannon. It may be noted that of the 197 vessels in the English fleet that defeated the Spanish Armada, only 34 belonged to the Royal Navy. The rest were armed merchantmen of various sizes, but mostly of a few hundred tons. In the next two centuries it was these small wooden ships, generally armed against pirates and other enemies, that colonized America and other parts of the world and spread the trade of Europe throughout the world, as well as carried on explorations.

The trend of shipbuilding in the seventeenth century was toward the type of the frigate. The high structures at the bow and stern (the forecastle and sterncastle) which were prevalent from Roman times and earlier, were now cut down. The frigate marked the great change in hull design that has been followed and improved upon since then. The frigate was truly an English design, the first being the Countess of Warwick, launched in 1647. The French improved upon the original model and made faster and larger types. These were copied by British and American shipbuilders, but the French maintained the lead in ship design until the beginning of the nineteenth century.

At the end of the eighteenth century a great improvement was made by the introduction of the steering wheel to control the rudder ropes. Before the seventeenth century most attention had always been devoted to warships. Merchant ships seemed to have been allowed to grow up as best they could; but now world trade began to expand rapidly. Trade across the Atlantic was increasing and the Portuguese and Dutch and English began seeking the rich products of the Orient. The East India Company organized its fleet of armed merchantmen of 600-tons burden to fight their way past opposition of the Portuguese and to fight piracy. Other nations formed their trading companies along similar lines, and this was the beginning of the great modern shipping companies. Intense rivalries sprang up among these.

Wooden warships continued to increase in size; and in the first half of the nineteenth century they were as much as 200 feet long, 55 feet beam and 3,000-tons burden. During the eighteenth century merchant ships built along the lines of the frigate increased in size and speed; and American shipyards began producing ships of their own design.



Seventeenth-century vessels, tossed about by a storm at sea. In their effort to control world shipping at this time the British built their ships larger and larger. In this they excelled their principal competitors, the Dutch.

Courtesy, Columbian Rope Company

In the rivalry between England and the United States for the control of ocean trade, each country attempted to build speedier ships. The high point in the competition was reached during the era of the clippers. These were the fastest wooden ships ever known. One of the last clippers was the America, launched in New York in 1853.

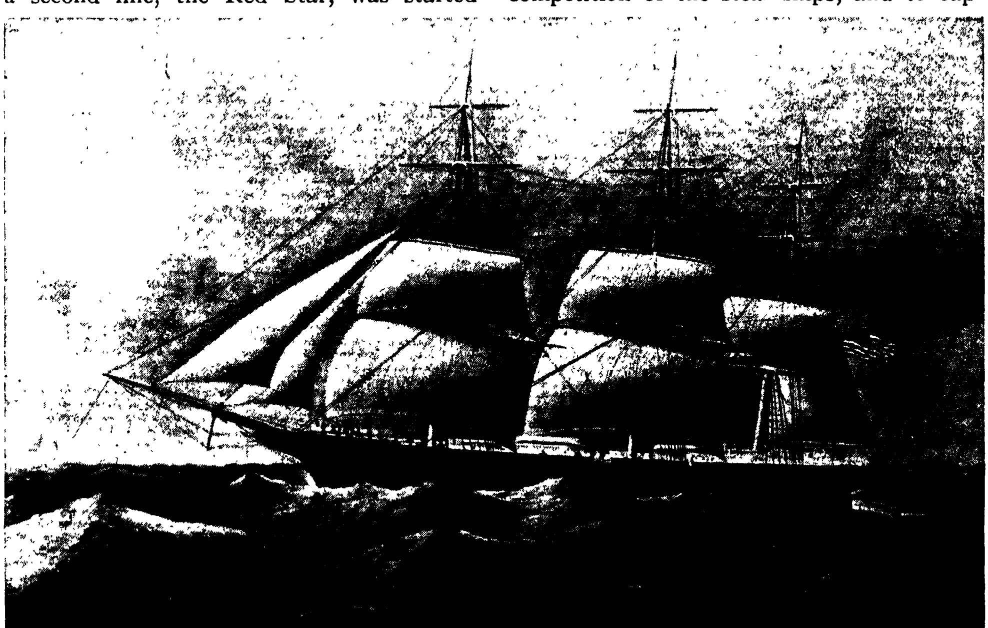
In 1745 the first two-mast schooner was built, and this typical American sailing vessel was first used in coastwise trade and as a fishing ship. Late in the nineteenth century the schooner's size was greatly increased to 4,000 or 5,000 tons, with four to six masts.

During the American Revolution many privateers of American build did great damage to British shipping. (A privateer was an armed ship owned by a private person or company and having government permission to engage in war activities.) After the Revolution the United States began the building of frigates as warships. They were much lighter and faster than the British frigates, and more than held their own against British ships of their class in the War of 1812. After this war a great rivalry for the carrying trade across the Atlantic began to spring up between British and American shipping companies using packet ships. A packet ship carried both passengers and cargo.

In 1816, Isaac Wright of New York founded the first ship line, the Black Ball line, so called from the black dot on its white pennant. The ships sailed at first once a month regularly between New York and Liverpool. A London line, followed by a Havre line, was soon started, and in 1821 a second line, the Red Star, was started between New York and Liverpool. New lines and more ships gave regular sailings to South America and other regions. The first ships were about 500-tons burden, and by 1845 had increased to ships of 1,000 tons.

The average time from New York to Liverpool was 23 days, and returning (against prevailing winds) the time was about 40 days. Here are some special runs from New York to Liverpool by later ships: in 16 days by the Canada, and less than 14 days by the Red Jacket. In 1838 and 1840, English steamships were built and sent out to compete with these packet lines. At first they made little better time, but in a few years their increased speed and greater carrying capacity gave them the advantage.

In the meantime there had grown up various branches of trade in which quick delivery meant larger profits, such as the tea trade with China, the spice trade with the Indies, the Australian wool trade, and later the discovery of gold in California. Time was very important on these long-distance runs. The ships that reached New York or Liverpool first from the Orient earned large bonuses, as the first cargoes of the season brought the highest prices. To meet the competition of the steamships, and to cap-



Brown Brothers

The Lightning, one of the most famous of the old clipper ships. On its maiden (first) voyage this American-built vessel sailed from Boston to Liverpool, England, in less than fourteen days. In one day it made 436 nautical miles.

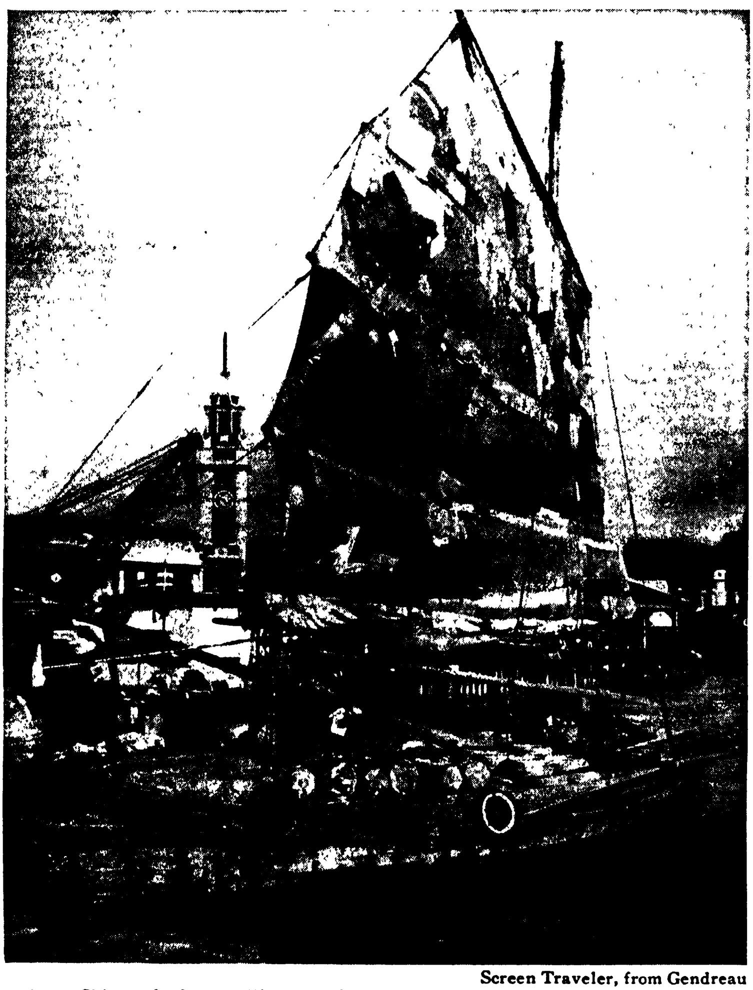
ture the trade of the Orient, the shipyards of the United States began building fast clipper ships. The word clipper was made from "clip," to move swiftly.

The first clipper, the Helena, was built in New York in 1841. She was 135 feet long, and had a 30 feet 6 inches beam and a 20 feet depth of hold. Following the Helena came the Rainbow, built in 1843 in New York. She was somewhat larger than the Helena. She also was put in the China trade, and made the round trip, New York to Canton and return, in less than six months. Other clippers now were built, and the owners of the Rainbow had the Sea Witch built. She was 170 feet long and had a 34-foot beam and was of 890 tons. She was the fastest ship on the seas for three years. She made one voyage around Cape Horn to California in 97 days.

Every year now saw new and larger clippers built, and the British went in for this type of ship to meet competition. In ten years clippers had reached 2,400 tons, with a length of 314 feet and a 49-foot beam. Records for crossing the Atlantic or sailing to the Pacific ports were greatly lowered. The Lightning, built in 1853, sailed from Boston to Liverpool in less than 14 days, and one day's run was 436 miles; that was the best record for a day's run of any sailing vessel in any age. The Dreadnaught, in 1859, made the trip from New York to Liverpool in 13 days, 8 hours; and later, from New York to Queenstown, Ireland, in less than 10 days.

These ships carried an enormous spread of sail. The Lightning had a mainmast 164 feet in height and carried 13,000 square yards of canvas. The decline of the clipper was almost as abrupt as its rise. England led all nations in building steam engines, and the discovery of the Bessemer steel process in 1856 gave an abundance of materials for the steel steamship which quickly supplanted the wooden sailing vessel. The brief reign of the clipper did, however, serve to put shipbuilding on a scientific basis. It is interesting to compare them in size and speed with the modern steel giants of the sea.

By E. C. McDowell.

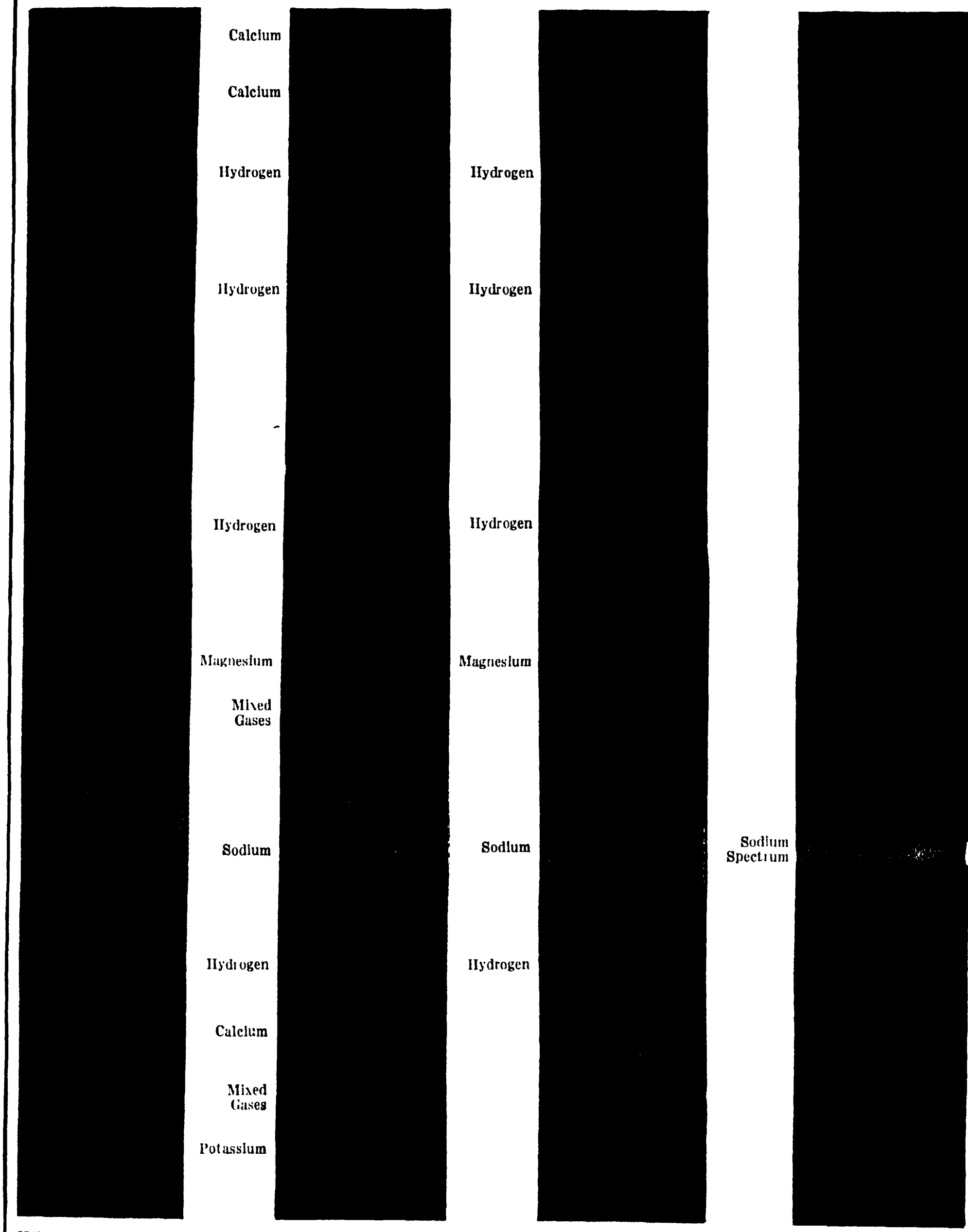


Screen Traveler, from Gendreau

A large Chinese junk, or sailing vessel, tied up at a dock near Hong Kong. Boats of this type are used in the Far East for river and harbor trade.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3955.

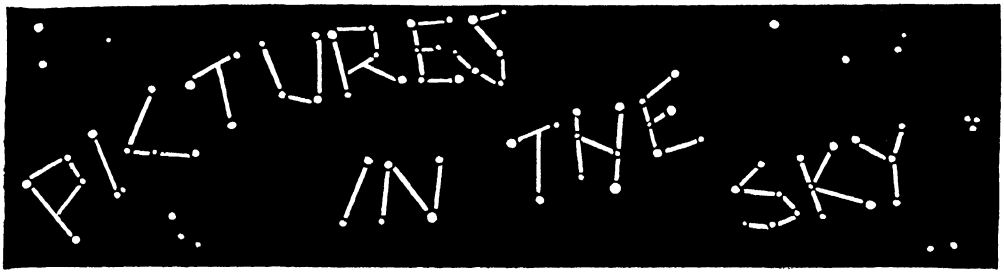
THE LIGHT THAT EXPLAINS THE STARS TO US



When pure light, as from a white-hot iron, passes through a glass prism, it is broken up into seven colors, called the spectrum, as shown in the first picture. But light from the sun shows, in addition to the colors, various lines, as seen in the second picture. These lines are caused by some of the different substances that compose the sun. Although here we see only a few lines, the sun's spectrum really shows over 2,000 lines. The third picture is the spectrum of a star, Sirius, and when compared with that of the sun, it shows that the stars are made of the same materials as the sun and earth, because the lines in the spectrum for different substances always appear in the same position in relation to each other, as can be seen by comparing these spectra of the sun and Sirius. Although the spectrum color of the metal sodium is yellow, as in the fourth picture, this appears dark in the sun and star spectra because of the intense light behind it, just as a gas-jet seen in front of the sun's disk appears black; but of course sodium is in the same position in all the spectra.

HOW THE STARLIGHT TELLS US OF WHAT THE STARS ARE MADE

This picture shows us how the spectroscope is used to enable men to catch the light of a star and by passing it through a glass prism to break up the light into various colors As different metals give off different colors we can in this way tell of what the stars are made This picture does not show the whole spectroscope but illustrates the principle



THE GROUPS OF STARS WHICH WE CALL CONSTELLATIONS

THE earliest star-gazers gave names to the stars. Only the brightest stars bear names, now, but all the sky is marked out in named areas, called constellations. These constellations are like the states of the United States or the provinces of Canada; they take up all the space and they are of various sizes and shapes. The names of some of the constellations no longer have any meaning for us, but we know that many of the names are those of gods and goddesses, heroes and heroines, and animals and birds and other objects that were well known in ancient Greece and Rome.

Now let us begin to get acquainted with the stars. The best place to begin is up in the northern sky, for up there is a group of stars called the Big Dipper. It looks like a dipper. There are seven stars in it, all of them easy to see. In January, the Big Dipper stands on the end of its handle, in the northeast; in April, you look up high in the north and you find the dipper upside down; in July it is high in the northwest, hanging by the end of its handle; in October, it is low on the northern horizon, right side up. That is how you will find it at about ten o'clock in the evening, at those times of the year.

Because the earth rotates, or spins, on its axis, the whole sky appears to roll across from east to west each twenty-four hours. Up in the northern sky east to west means in the direction opposite to that in which the hands of the clock travel. So, as the hours pass by you will see the Big Dipper moving around in a big circle backward as compared with the clock's hands. The Big Dipper never sets, nor do many of the other stars up in our northern sky.

Whenever you can find the Big Dipper, you can be sure to find the North Star, whose real name is Polaris. Look for the two stars in the front of the cup of the dipper. Draw a line through them and extend that line upward from the cup. Upward means away from the bottom of the cup. When you have gone about one dipper-length upward, you will come to a fairly lonely star of moderate brightness; this is Polaris, the North Star. It is always to be found there, a little less than halfway up in the northern sky for most of us who live in the United States and Canada. If you live far south, the star will be a little lower down.

Because the earth's axis points almost at the North Star, that star appears to stand almost still as the earth spins. Actually it travels in a small circle—one so small that unless you use some kind of instrument, or mechanical sight, you will not be able to see that it moves at all. Whenever you can find that star and look toward it, you are looking north, as nearly as you need to know it.

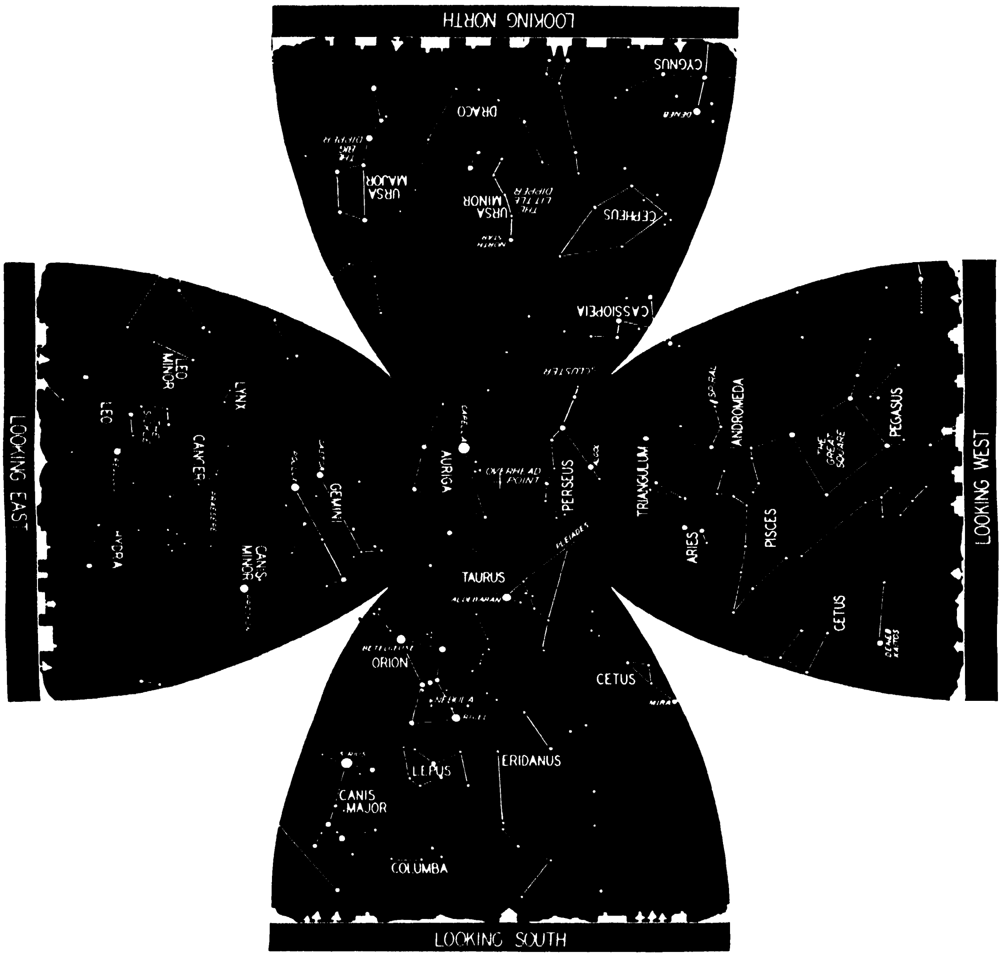
The North Star is in the end of the handle of the Little Dipper, another group of stars, which is not very little at all, but is not so big as the Big Dipper. There are two fair stars between Polaris and the handle of the Big Dipper; these help to form the cup of the Little Dipper. Other faint stars make up the rest of it.

Now these dippers are not real constellations. In England, the Big Dipper is known as the Plow, and it does look like one. The constellations are Ursa Major, the greater bear, and Ursa Minor, the smaller bear. The handles of the dippers are the tails of the bears, and they are quite long because when Jupiter put the bears into the sky he pulled them up by their tails, and the tails stretched! The bears were originally people; Ursa Major was the nymph Callisto and Ursa Minor was her son, whose name, Arcas, gave the Greeks the word for bear, and has given us the word arctic, describing one of the regions where bears are found.

When you have found the Big Dipper,

draw a line from the end of its handle through the North Star and extend it an equal distance beyond. You will find a zigzag line of stars that resembles a sprawling letter "W". *This is the conspicuous part of the constellation Cassiopeia, the queen of Ethiopia,* who was so vain because of her beauty that the

Imagine that you are looking at the evening sky in February. If you look over into the west, you find a very good square of bright stars, standing on one of its corners. It is a big square, stretching from the horizon to a point about a third of the way up to the zenith, which is the point exactly overhead.



All maps, from STAR MAPS FOR BEGINNERS by Marshall and Levitt

This map represents the sky at the following standard times (for daylight-saving time, add one hour): January 1, at 10 P.M.; January 16, at 9 P.M.; February 1, at 8 P.M. The Little Dipper stretches north from the Pole Star.

gods punished her and her husband, the king, whose name was Cepheus. He is in the sky, too, but his stars are not very bright. Their daughter, the princess Andromeda, is also in the sky. She was about to be eaten up by a sea monster when she was rescued by Perseus. Both Perseus and the sea monster, Cetus, are in the sky, and are best seen in the winter.

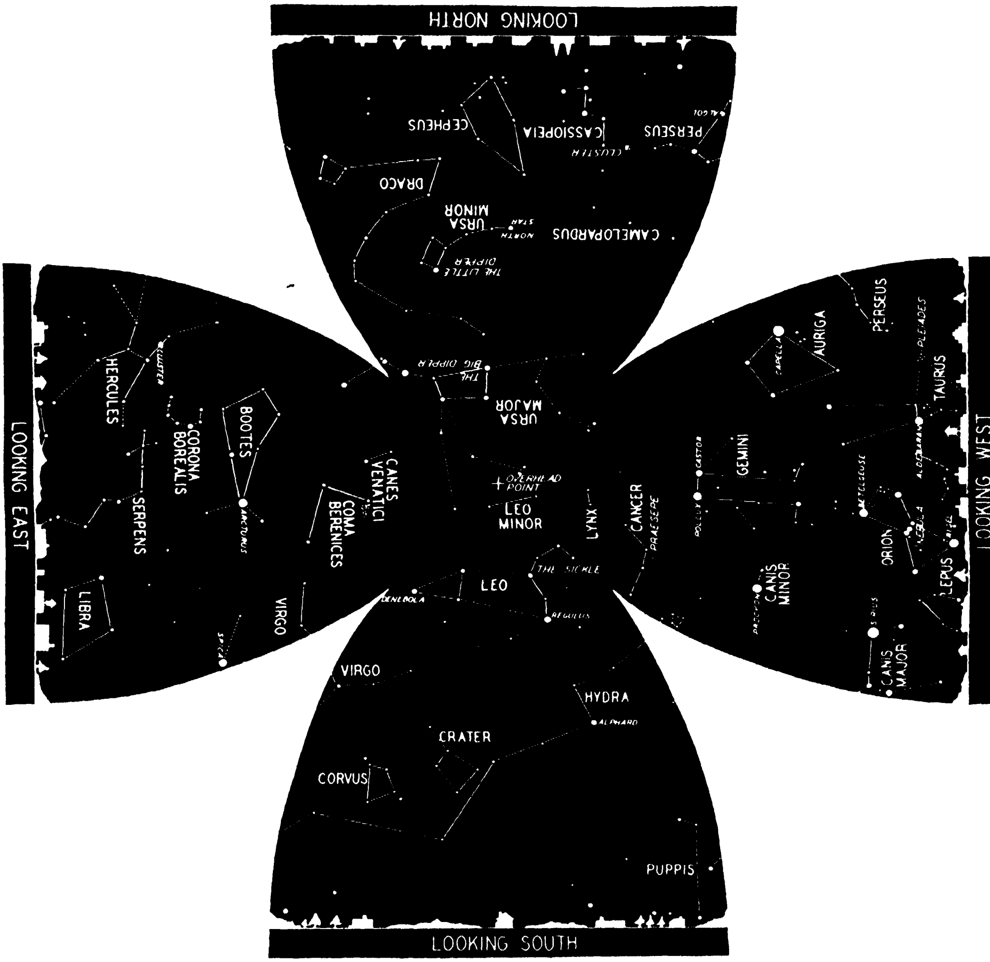
This is the Great Square of Pegasus; it forms the shoulder of the lovely winged horse, Pegasus. The uppermost star in the square belongs to Andromeda; two other bright stars straight up from the square are also in Andromeda, along with some fainter ones.

Above Andromeda is Perseus, the hero, who was returning from the task of cutting

off the head of the Gordon, Medusa, when he saw Andromeda chained to the rocks to be devoured by the sea monster. Cetus, the monster, is also in the western sky.

The finest part of the February sky is the southern part. About halfway up stands Orion, the great hunter, the most beautiful star Rigel, down to the right of the belt.

The brightest star in all the heavens is Sirius, down to the left of Orion. It is called the Dog Star, because it marks an ornament in the collar of the greater dog, Canis Major. When Orion is in the south, Sirius is about half as far above the horizon as Betelgeuse

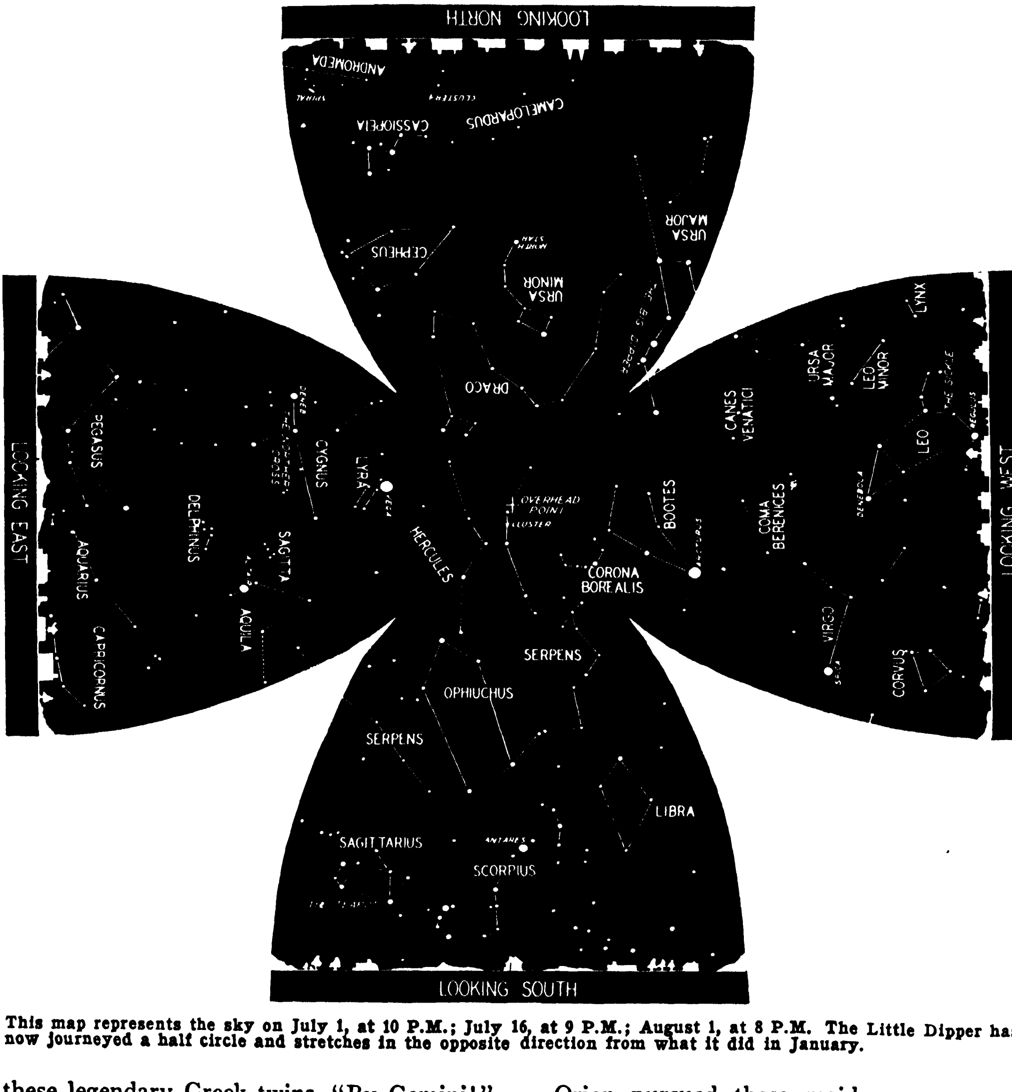


This map represents the sky on April 1, at 10 P.M.; April 16, at 9 P.M.; May 1, at 8 P.M. Notice that the Little Dipper has now swung to the east and that the constellation of Orion is quite low in the west.

of all constellations. Many people know the three stars, so nicely lined up and evenly matched in brightness, that mark Orion's belt. Up to the left of the belt is the orange star Betelgeuse, marking Orion's right shoulder; to the right of this star is Bellatrix, that marks his left shoulder. Orion's upraised left foot is the brilliant blue-white is. Then look for the third corner of the triangle, up about as high as Betelgeuse but as far east of it as Sirius is southeast of it. This third corner is the star Procyon, in Canis Minor, the lesser dog.

Above Procyon, in the February sky, we find Castor and Pollux, the twin stars. We call them that because they mark the heads

of the twins, Gemini, who were the sons of Leda and Jupiter. One of the twins was an expert horseman, the other was skilled at boxing and wrestling. The Roman soldiers considered them as patron deities and used to swear by them. If you have ever said, "By Jiminy!" you have been swearing by account for the missing, or lost, Pleiad. One story is that Electra, one of them, was the mother of Dardanus, who founded the city of Troy. When the Greeks burned and destroyed Troy, Electra did not want to watch what was happening, so she withdrew from the heavens and has not been seen since.



This map represents the sky on July 1, at 10 P.M.; July 16, at 9 P.M.; August 1, at 8 P.M. The Little Dipper has now journeyed a half circle and stretches in the opposite direction from what it did in January.

these legendary Greek twins, "By Gemini!"

If you draw a line through the belt of Orion and extend it up the right, you will come to the neighborhood of the little cluster of stars called the Pleiades. They were the seven daughters of Atlas and Pleione; but only six stars can be seen with the average unaided eye. There are several stories to

Orion pursued these maidens once, and Jupiter changed them first into doves, then into stars, and put them in the sky. But as the hours of the night pass, Orion still follows them across the sky.

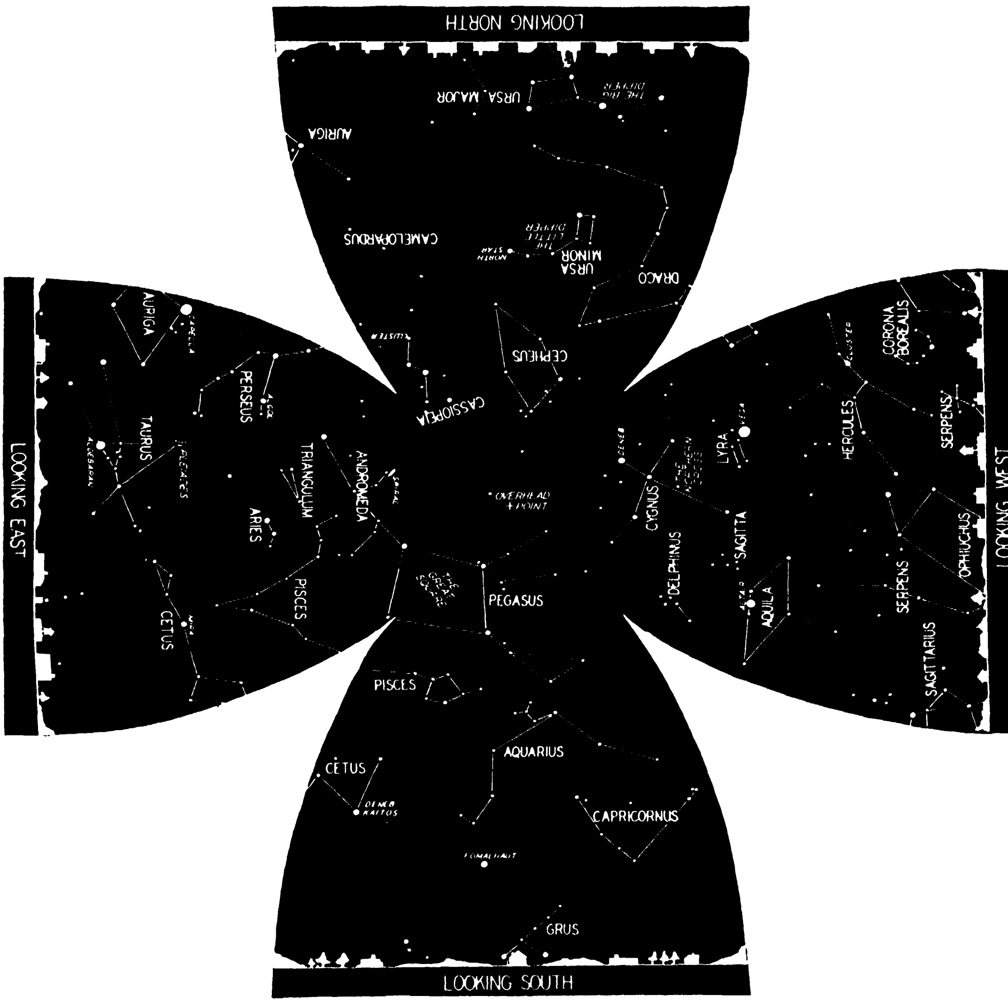
The Pleiades are in the shoulder of Taurus, the bull. The face of Taurus is marked by a "V" of stars between the Pleiades and

Orion. The bright orange star at the end of one branch of the "V" is Aldebaran, in the right eye of Taurus.

When a line is drawn straight up through the middle of Orion and extended beyond the top of the constellation, it comes at last to a bright yellow star named Capella. This name means the "little she-goat" and the star does mark a little mother-goat. Near the star is a triangle of faint stars and these are called the Kids because they are supposed to be the baby goats. They are all on the left arm of Auriga, the charioteer. This man is more than the driver of a chariot; he is supposed to be Erichthonius, the inventor of the chariot, who was lame. By inventing the two-wheeled vehicle, Erichthonius was able to get around even better than his friends.

In April evenings, Orion and Taurus are setting in the west. Gemini, the twins, are about halfway up in the west. Look up in the north, twice as high as the North Star, and you will find the Big Dipper, upside down. Draw a line through the cup of the dipper and extend it in the direction away from the North Star. You will come to Leo, the lion, slain by the great hero, Hercules.

The head and mane of Leo are marked by a curled line of stars that is shaped like a sickle, or a question mark turned backward.



This map represents the sky on October 1, at 10 P.M.; October 16, at 9 P.M.; November 1, at 8 P.M. The Little Dipper has now swung to the west, and the Great Square of Pegasus is high in the southeast.

The bottom of this group is the bright star Regulus. The tip of the lion's tail is the bright star Denebola, over to the east.

Now return once more to the Big Dipper. Look at the handle; extend the curve of the handle about one dipper-length, and you will come to the bright orange star Arcturus, in the constellation Boötes, the bear-driver. It is called that because, as the bears go around the North Star as the earth rotates, Boötes seems to be chasing them.

THE CORONA BOREALIS, ARIADNE'S WEDDING GIFT, IN THE EAST ON APRIL EVENINGS

In the east below and to the left of Arcturus there is a fine little group of stars shaped like a "C" turned backward. This is Corona Borealis, the northern crown. It is the golden crown given by Bacchus to Ariadne as a wedding gift and later taken to the sky.

In July, Leo is setting and Corona is almost overhead. In the south, a find red star shines low, flanked by a star on either side. A string of stars curves down and then upward to the left, ending in a pair. This is Scorpius, the scorpion. Antares, the red star, is the heart of the scorpion. To the left of the curled tail of the scorpion, a group of stars shaped like a teapot marks the important part of Sagittarius, the archer, who is a centaur. The centaurs were mythical creatures with the upper parts of men's bodies attached to the bodies of horses.

The fairest star in this summer sky is Vega, standing about two-thirds of the way up the eastern sky. It is blue-white and is the brightest star in Lyra, the lyre of Orpheus. He was such a magical musician that even the birds and beasts came to listen as he played and sang. When he died, the gods put the lyre into the sky as a memento of his music and as a tribute to his deathless love for Eurydice, his wife. The other stars of Lyra are faint as compared with Vega. Below Lyra and lying on its side in the bright summer Milky Way is the Northern Cross, with its head to the left, or north. The head of the cross is marked by the star Deneb. This constellation is really Cygnus, the swan, and Deneb, a star whose name means "tail," is in the middle of the tail of the bird.

Another bird is in the eastern sky, to the right of Cygnus. This is Aquila, the eagle, which has in it the bright star Altair, with a star below and above it. This is the eagle into which Jupiter transformed himself when he came down to earth to find Ganymede, the cup-bearer to the gods on Mount Olympus.

The Milky Way is a complete band all the way around the sky. The part we see in the summer is the brightest. It can be seen in the south, passing through the tail of Scorpius and through Sagittarius; then it swings into the eastern sky and passes through Aquila and Cygnus. In the north, Cassiopeia is in a bright part of it. In the winter sky, the Milky Way passes down through Perseus and the feet of the twins, Gemini, then just east of Orion and through Canis Major before disappearing below our southern horizon.

The Milky Way consists of almost countless millions of stars. They are too far away from us and thus appear too faint to be picked out separately without a large telescope; if we have no telescope, we find that the stars blend their light together to make the lovely veil of light flung across the sky.

In October evenings, the Great Square of Pegasus is high in the south, while Sagittarius sets in the southwest. Taurus and Auriga are coming up north of east, while the Northern Cross stands almost upright in the west, high up. Below Pegasus, very low in the sky, a solitary bright star named Fomalhaut shines out. The constellations above it to either side are not very conspicuous, but they are important because they are some of those through which the sun appears to pass in the course of the year.

The earth revolves around the sun once each year. As we move along in our path, each day we stand in a different direction from the sun, so the sun appears to stand in a different direction. It appears to go all the way around the earth in a year and to pass through twelve constellations of the belt of the sky called the zodiac.

THE CONSTELLATIONS OF THE ZODIAC WHICH MARK THE SUN'S APPARENT YEARLY JOURNEY

These twelve constellations are Aries, the ram, Taurus, the bull, Gemini, the twins, Cancer, the crab, Leo, the lion, Virgo, the maiden, Libra, the scales, Scorpius, the scorpion, Sagittarius, the archer, Capricornus, the sea-goat, Aquarius, the old man with the water jar, and Pisces, the fishes. The last-named four and the first two are above the horizon in October. Of course, you can't see the constellations that are near the sun in the sky, because the bright sun blots them out by day. But by watching in the west just after sunset, to see what stars are there, you will find that the sun moves along eastward among the stars, all the way around, once each year.

By ROY K. MARSHALL.

THE NEXT STORY OF EARTH IS ON PAGE 4042.

POETRY

The Rime of the Ancient Mariner

By SAMUEL TAYLOR COLERIDGE (1772-1834)

Illustrated by Lee Brown Coye

IT is an ancient Mariner,
And he stoppeth one of three.
"By thy long grey beard and glittering eye,
Now wherefore stopp'st thou me?

The Bridegroom's doors are opened wide,
And I am next of kin;
The guests are met, the feast is set:
May'st hear the merry din."

He holds him with his skinny hand,
"There was a ship," quoth he.
"Hold off! unhand me, grey-beard loon!"
Eftsoons his hand dropt he.

He holds him with his glittering eye—
The Wedding-Guest stood still,
And listens like a three years' child:
The Mariner hath his will.

The Wedding-Guest sat on a stone:
He cannot choose but hear;
And thus spake on that ancient man,
The bright-eyed Mariner.

"The ship was cheered, the harbor cleared,
Merrily did we drop
Below the kirk, below the hill,
Below the lighthouse top.

The Sun came up upon the left,
Out of the sea came he!
And he shone bright, and on the right
Went down into the sea.

Higher and higher every day,
Till over the mast at noon—"
The Wedding-Guest here beat his breast,
For he heard the loud bassoon.

The bride hath paced into the hall,
Red as a rose is she;
Nodding their heads before her goes
The merry minstrelsy.

The Wedding-Guest he beat his breast,
Yet he cannot choose but hear;
And thus spake on that ancient man,
The bright-eyed Mariner.

"And now the STORM-BLAST came, and he
Was tyrannous and strong:
He struck with his o'ertaking wings,
And chased us south along.

With sloping masts and dipping prow,
As who pursued with yell and blow
Still treads the shadow of his foe,
And forward bends his head,
The ship drove fast, loud roared the blast,
And southward aye we fled.

And now there came both mist and snow,
And it grew wondrous cold:
And ice, mast-high, came floating by,
As green as emerald.

And through the drifts the snow cliffs
Did send a dismal sheen:
Nor shapes of men nor beasts we ken—
The ice was all between.

The ice was here, the ice was there,
The ice was all around:
It cracked and growled, and roared and howled,
Like noises in a swound!

At length did cross an Albatross,
Thorough the fog it came;
As if it had been a Christian soul,
We hailed it in God's name.

It ate the food it ne'er had eat,
And round and round it flew.
The ice did split with a thunder-fit;
The helmsman steered us through!

And a good south wind sprung up
behind;
The Albatross did follow,
And every day, for food or play,
Came to the mariner's hollo!

In mist or cloud, on mast or shroud,
It perched for vespers nine;
Whiles all the night, through fog-smoke
white,
Glimmered the white Moon-shine."

"God save thee, ancient Mariner!
From the fiends, that plague thee thus!—
Why look'st thou so?"
—"With my cross-bow
I shot the ALBATROSS."

The Sun now rose upon the right:
Out of the sea came he,
Still hid in mist, and on the left
Went down into the sea.

And the good south wind still blew
behind,
But no sweet bird did follow,
Nor any day for food or play
Came to the mariner's hollo!

And I had done a hellish thing,
And it would work 'em woe:
For all averred, I had killed the bird
That made the breeze to blow.
Ah wretch! said they, the bird to slay,
That made the breeze to blow!

Nor dim nor red, like God's own head,
The glorious Sun uprist:
Then all averred, I had killed the bird
That brought the fog and mist.
'Twas right, said they, such birds to slay,
That bring the fog and mist.

The fair breeze blew, the white foam
flew.
The furrow followed free;
We were the first that ever burst
Into that silent sea.

Down dropt the breeze, the sails dropt
down,
'Twas sad as sad could be;
And we did speak only to break
The silence of the sea!

All in a hot and copper sky,
The bloody Sun, at noon,
Right up above the mast did stand,
No bigger than the Moon.

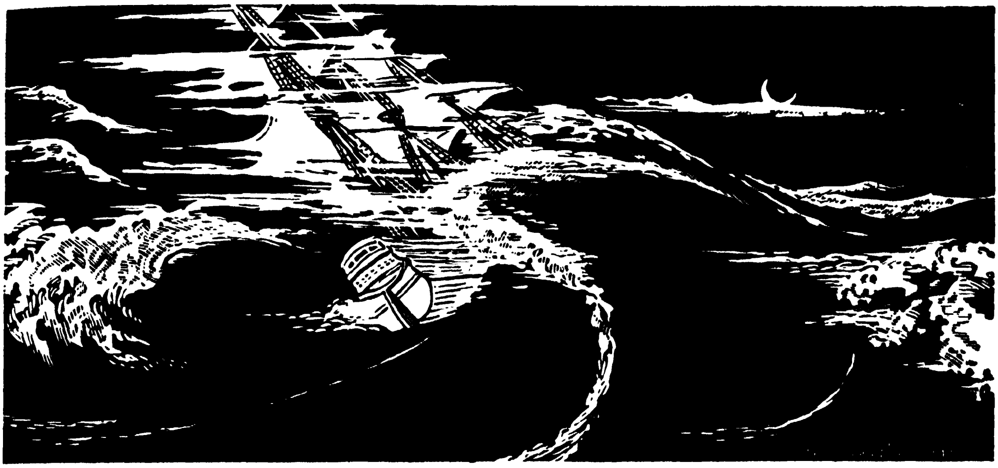
Day after day, day after day,
We stuck, nor breath nor motion;
As idle as a painted ship
Upon a painted ocean.

Water, water, every where,
And all the boards did shrink;
Water, water, every where,
Nor any drop to drink.

**And thus spake on that ancient man,
The bright-eyed Mariner.**

The very deep did rot: O Christ!
That ever this should be!
Yea, slimy things did crawl with legs
Upon the slimy sea.

About, about, in reel and rout
The death-fires danced at night;
The water, like a witch's oils,
Burnt green and blue, and white.



The ship drove fast, loud roared the blast, And southward aye we fled.

And some in dreams assurèd were
Of the Spirit that plagued us so;
Nine fathom deep he had followed us
From the land of mist and snow.

And every tongue, through utter drought,
Was withered at the root;
We could not speak, no more than if
We had been choked with soot.

Ah, well a-day! what evil looks
Had I from old and young!
Instead of the cross, the Albatross
About my neck was hung.

There passed a weary time. Each throat
Was parched, and glazed each eye.
A weary time! a weary time!
How glazed each weary eye,
When looking westward, I beheld
A something in the sky.

At first it seemed a little speck,
And then it seemed a mist;
It moved and moved, and took at last
A certain shape, I wist.

A speck, a mist, a shape, I wist!
And still it neared and neared:
As if it dodged a water-sprite,
It plunged and tacked and veered.

With throats unslaked, with black lips baked,
We could nor laugh nor wail;
Through utter drought all dumb we stood!
I bit my arm, I sucked the blood,
And cried, A sail! a sail!

With throats unslaked, with black lips
baked,
Agape they heard me call:
Gramercy! they for joy did grin,
And all at once their breath drew in,
As they were drinking all.

See! see! (I cried) she tacks no more!
Hither to work us weal;
Without a breeze, without a tide,
She steadies with upright keel!

The western wave was all a-flame,
The day was well nigh done!
Almost upon the western wave
Rested the broad bright Sun;
When that strange shape drove
suddenly
Betwixt us and the Sun.

And straight the Sun was flecked with bars,
(Heaven's Mother send us grace!)
As if through a dungeon-grate he peered
With broad and burning face.

Alas! (thought I, and my heart beat loud)
How fast she nears and nears!
Are those *her* sails that glance in the
Sun,
Like restless gossameres?

Are those *her* ribs through which the
Sun
Did peer, as through a grate?
And is that Woman all her crew?
Is that a DEATH, and are there two?
Is DEATH that woman's mate?

Her lips were red, *her* looks were free,
Her locks were yellow as the gold:
Her skin was as white as leprosy,
The Night-mare LIFE-IN-DEATH was she,
Who thicks man's blood with cold.

The naked hulk alongside came,
And the twain were casting dice;
"The game is done! I've won! I've won!"
Quoth she, and whistles thrice.

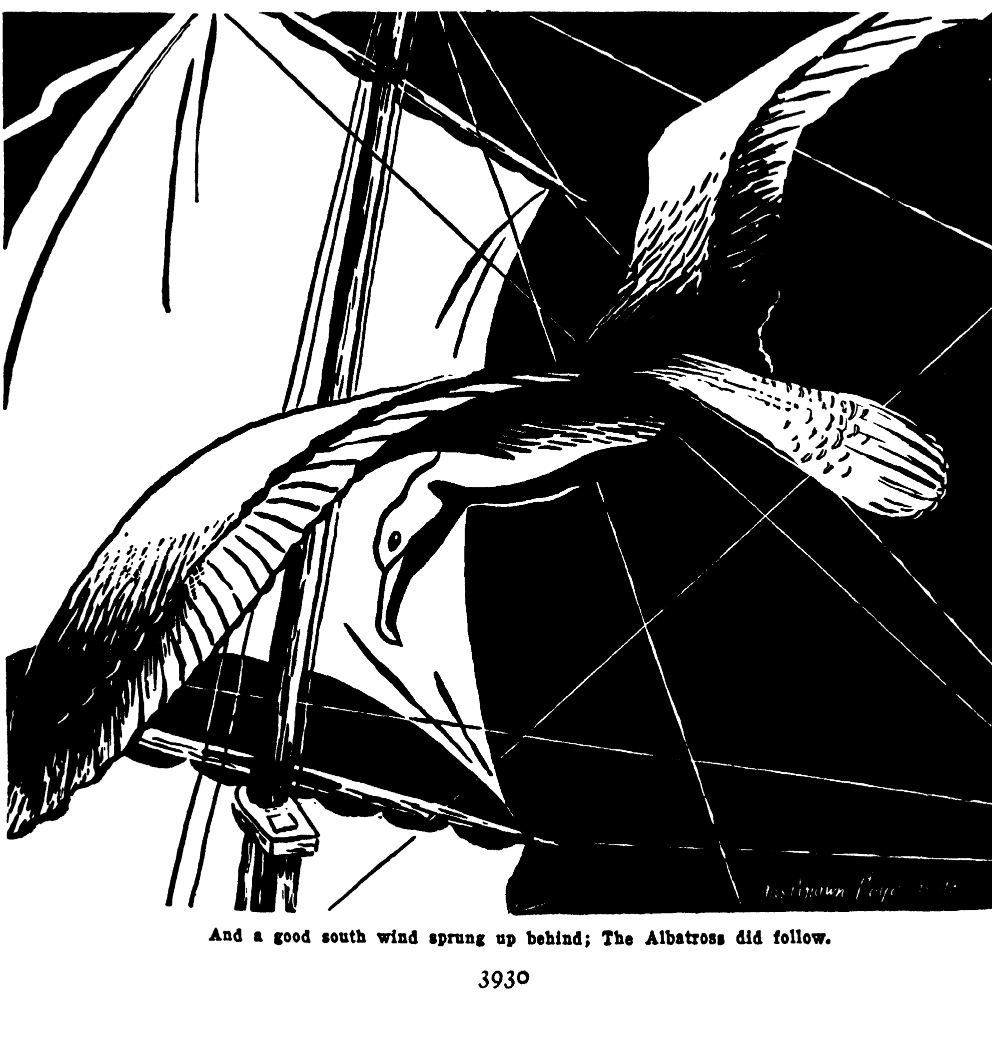
The Sun's rim dips: the stars rush out:
At one stride comes the dark;
With far-heard whisper, o'er the sea,
Off shot the spectre-bark.

We listened and looked sideways up!
Fear at my heart, as at a cup,
My life-blood seemed to sip!

The stars were dim, and thick the night,
The steersman's face by his lamp gleamed
white;
From the sails the dew did drip—
Till clomb above the eastern bar
The hornèd Moon, with one bright star
Within the nether tip.

One after one, by the star-dogged
Moon,
Too quick for groan or sigh,
Each turned his face with a ghastly
pang,
And cursed me with his eye.

Four times fifty living men,
(And I heard nor sigh nor groan)
With heavy thump, a lifeless lump,
They dropped down one by one.



And a good south wind sprung up behind; The Albatross did follow.

The souls did from their bodies fly,—
They fled to bliss or woe!
And every soul, it passed me by,
Like the whizz of my cross-bow!

"I fear thee, ancient Mariner!
I fear thy skinny hand!
And thou art long, and lank, and brown,
As is the ribbed sea-sand.

I fear thee and thy glittering eye,
And thy skinny hand, so brown." —
"Fear not, fear not, thou Wedding-Guest!
This body dropt not down.

Alone, alone, all, all alone,
Alone on a wide wide sea!
And never a saint took pity on
My soul in agony.

The many men, so beautiful!
And they all dead did lie:
And a thousand thousand slimy things
Lived on; and so did I.

I looked upon the rotting sea,
And drew my eyes away;
I looked upon the rotting deck,
And there the dead men lay.

I looked to heaven, and tried to pray;
But or ever a prayer had gusht,
A wicked whisper came, and made
My heart as dry as dust.

I closed my lids, and kept them close,
And the balls like pulses beat;
For the sky and the sea, and the sea and the
sky
Lay like a load on my weary eye,
And the dead were at my feet.

The cold sweat melted from their
limbs,
Nor rot nor reek did they:
The look with which they looked on me
Had never passed away.

An orphan's curse would drag to hell
A spirit from on high;
But oh! more horrible than that
Is the curse in a dead man's eye!
Seven days, seven nights, I saw that curse,
And yet I could not die.

The moving Moon went up the sky,
And no where did abide:
Softly she was going up,
And a star or two beside—

The Albatross about my neck was hung.

Her beams bemocked the sultry main,
Like April hoar-frost spread;
But where the ship's huge shadow lay,
The charmèd water burnt alway
A still and awful red.

Beyond the shadow of the ship,
I watched the water-snakes:
They moved in tracks of shining
white,
And when they reared, the elfish
light
Fell off in hoary flakes.

Within the shadow of the ship
I watched their rich attire:
Blue, glossy green, and velvet black,
They coiled and swam; and every track
Was a flash of golden fire.

O happy living things! no tongue
Their beauty might declare:
A spring of love gushed from my heart,
And I blessed them unaware:
Sure my kind saint took pity on me,
And I blessed them unaware.

The self-same moment I could pray;
And from my neck so free
The Albatross fell off, and sank
Like lead into the sea.

Oh sleep! it is a gentle thing,
Beloved from pole to pole!
To Mary Queen the praise be given!
She sent the gentle sleep from Heaven,
That slid into my soul.

The silly buckets on the deck,
That had so long remained,
I dreamt that they were filled with dew;
And when I awoke, it rained.

My lips were wet, my throat was cold,
My garments all were dank;
Sure I had drunken in my dreams,
And still my body drank.

I moved, and could not feel my limbs:
I was so light—almost
I thought that I had died in sleep,
And was a blessèd ghost.

And soon I heard a roaring wind:
It did not come anear;
But with its sound it shook the sails,
That were so thin and sere.

The upper air burst into life!
And a hundred fire-flags sheen,
To and fro they were hurried about!
And to and fro, and in and out,
The wan stars danced between.

And the coming wind did roar more loud,
And the sails did sigh like sedge;
And the rain poured down from one black cloud;
The Moon was at its edge.

The thick black cloud was cleft, and still
The Moon was at its side:
Like waters shot from some high crag,
The lightning fell with never a jag,
A river steep and wide.

The loud wind never reached the ship,
Yet now the ship moved on!
Beneath the lightning and the Moon
The dead men gave a groan.

They groaned, they stirred, they all uprose,
Nor spake, nor moved their eyes;
It had been strange, even in a dream,
To have seen those dead men rise.

The helmsman steered, the ship moved on;
Yet never a breeze up-blew;
The mariners all 'gan work the ropes,
Where they were wont to do;
They raised their limbs like lifeless tools—
We were a ghastly crew.

The body of my brother's son
Stood by me, knee to knee:
The body and I pulled at one rope,
But he said nought to me.- -

"I fear thee, ancient Mariner!"—
Be calm, thou Wedding-Guest!
'Twas not those souls that fled in pain,
Which to their corses came again,
But a troop of spirits blest:

For when it dawned—they dropped their arms,
And clustered round the mast;
Sweet sounds rose slowly through their mouths,
And from their bodies passed.

Around, around, flew each sweet sound,
Then darted to the Sun;
Slowly the sounds came back again,
Now mixed, now one by one.

Sometimes a-dropping from the sky
I heard the sky-lark sing;
Sometimes all little birds that are,
How they seemed to fill the sea and air
With their sweet jargoning!

And now 'twas like all instruments,
Now like a lonely flute;
And now it is an angel's song,
That makes the heavens be mute.

It ceased; yet still the sails made on
A pleasant noise till noon,
A noise like of a hidden brook
In the leafy month of June,
That to the sleeping woods all night
Singeth a quiet tune.

Till noon we silently sailed on,
Yet never a breeze did breathe:
Slowly and smoothly went the ship,
Moved onward from beneath.

The western wave was all a-flame. . . . When that strange shape drove suddenly Betwixt us and the Sun.

Under the keel nine fathom deep,
From the land of mist and snow,
The spirit slid: and it was he
That made the ship to go.
The sails at noon left off their tune,
And the ship stood still also.

The Sun, right up above the mast,
Had fixed her to the ocean;
But in a minute she 'gan to stir,
With a short uneasy motion—
Backwards and forwards half her length
With a short uneasy motion.

Then like a pawing horse let go,
She made a sudden bound:
It flung the blood into my head,
And I fell down in a swound.

How long in that same fit I lay,
I have not to declare;
But ere my living life returned,
I heard and in my soul discerned
Two voices in the air.

"Is it he?" quoth one, "Is this the man?
By Him who died on cross,
With his cruel bow he laid full low
The harmless Albatross.

The spirit who bideth by himself
In the land of mist and snow,
He loved the bird that loved the man
Who shot him with his bow."

The other was a softer voice,
As soft as honey-dew:
Quoth he, "The man hath penance done,
And penance more will do."

First Voice. "But tell me, tell me! speak again,
Thy soft response renewing—
What makes that ship drive on so fast?
What is the ocean doing?"

Second Voice. "Still as a slave before his lord,
The ocean hath no blast;
His great bright eye most silently
Up to the Moon is cast—

If he may know which way to go;
For she guides him smooth or grim.
See, brother, see! how graciously
She looketh down on him."

First Voice. "But why drives on that ship so fast,
Withouten wave or wind?"

Second Voice. "The air is cut away before,
And closes from behind.

Fly, brother, fly! more high, more high!
Or we shall be belated:
For slow and slow that ship will go,
When the Mariner's trance is abated."—

I woke and we were sailing on
As in a gentle weather:
'Twas night, calm night, the moon was high;
The dead men stood together.

All stood together on the deck,
For a charnel-dungeon fitter:
All fixed on me their stony eyes,
That in the Moon did glitter.

The pang, the curse, with which they died,
Had never passed away:
I could not draw my eyes from theirs,
Nor turn them up to pray.

And now this spell was snapt: once more
I viewed the ocean green,
And looked far forth, yet little saw
Of what had else been seen —

Like one, that on a lonesome road
Doth walk in fear and dread,
And having once turned round walks on,
And turns no more his head;
Because he knows, a frightful fiend
Doth close behind him tread.

But soon there breathed a wind on me,
Nor sound nor motion made;
Its path was not upon the sea,
In ripple or in shade.

It raised my hair, it fanned my cheek
Like a meadow-gale of spring—
It mingled strangely with my fears,
Yet it felt like a welcoming.

Swiftly, swiftly flew the ship,
Yet she sailed softly too:
Sweetly, sweetly blew the breeze—
On me alone it blew.

Oh! dream of joy! is this indeed
The light-house top I see?
Is this the hill? is this the kirk?
Is this mine own countree?

We drifted o'er the harbor-bar,
And I with sobs did pray —
O let me be awake, my God!
Or let me sleep alway.

The harbor-bay was clear as glass,
So smoothly it was strewn!
And on the bay the moonlight lay,
And the shadow of the Moon.

The rock shone bright, the kirk no less,
That stands above the rock:
The moonlight steeped in silentness
The steady weathercock.

And the bay was white with silent light,
Till rising from the same,
Full many shapes, that shadows were,
In crimson colours came.

A little distance from the prow
Those crimson shadows were:
I turned my eyes upon the deck—
Oh, Christ! what saw I there!

Each corse lay flat, lifeless, and flat,
And, by the holy rood!
A man all light, a seraph-man,
On every corse there stood.

This seraph-band, each waved his hand:
It was a heavenly sight!
They stood as signals to the land,
Each one a lovely light;

This seraph-band, each waved his hand,
No voice did they impart—
No voice; but, oh! the silence sank
Like music on my heart.

But soon I heard the dash of oars,
I heard the Pilot's cheer;
My head was turned perforce away,
And I saw a boat appear.

The Pilot and the Pilot's boy,
I heard them coming fast:
Dear Lord in Heaven! it was a joy
The dead men could not blast.

I saw a third—I heard his voice:
It is the Hermit good!
He singeth loud his godly hymns
That he makes in the wood.
He'll shrieve my soul, he'll wash away
The Albatross's blood.

This Hermit good lives in that wood
Which slopes down to the sea.
How loudly his sweet voice he rears!
He loves to talk with marineres
That come from a far countree.

He kneels at morn, and noon, and eve—
He hath a cushion plump:
It is the moss that wholly hides
The rotted old oak-stump.

The skiff-boat neared: I heard them talk,
"Why, this is strange, I trow!
Where are those lights so many and fair,
That signal made but now?"

"Strange, by my faith!" the Hermit said—
"And they answered not our cheer!
The planks look warped! and see those
sails,

IS THIS MINE OWN COUNTREE?

How thin they are and sere!
I never saw aught like to them,
Unless perchance it were

Brown skeletons of leaves that lag
My forest-brook along;
When the ivy-tod is heavy with snow,
And the owlet whoops to the wolf below,
That eats the she-wolf's young."

"Dear Lord! it hath a fiendish look—
(The Pilot made reply)
I am a-feared"—"Push on, push on!"
Said the Hermit cheerily.

The boat came closer to the ship,
But I nor spake nor stirred;
The boat came close beneath the ship,
And straight a sound was heard.

Under the water it rumbled on,
Still louder and more dread:
It reached the ship, it split the bay;
The ship went down like lead.

Stunned by that loud and dreadful sound,
Which sky and ocean smote,
Like one that hath been seven days drowned
My body lay afloat;
But swift as dreams, myself I found
Within the Pilot's boat.

Upon the whirl, where sank the ship,
The boat spun round and round;
And all was still, save that the hill
Was telling of the sound.

I moved my lips—the Pilot shrieked
And fell down in a fit;
The holy Hermit raised his eyes,
And prayed where he did sit.

I took the oars: the Pilot's boy,
Who now doth crazy go,
Laughed loud and long, and all the while
His eyes went to and fro.
"Ha! ha!" quoth he, "full plain I see,
The Devil knows how to row."

And now, all in my own countree,
I stood on the firm land!
The Hermit stepped forth from the boat,
And scarcely he could stand.

"O shrieve me, shrieve me, holy man!"
The Hermit crossed his brow.
"Say quick," quoth he, "I bid thee say—
What manner of man art thou?"

Forthwith this frame of mine was wrenched
With a woful agony,
Which forced me to begin my tale;
And then it left me free.

Since then, at an uncertain hour,
That agony returns:
And till my ghastly tale is told,
This heart within me burns.

I pass, like night, from land to land;
I have strange power of speech;
That moment that his face I see,
I know the man that must hear me:
To him my tale I teach.

What loud uproar bursts from that door!
The wedding-guests are there:
But in the garden-bower the bride
And bride-maids singing are:
And hark the little vesper bell,
Which biddeth me to prayer!

O Wedding-Guest! this soul hath been
Alone on a wide wide sea:
So lonely 'twas that God himself
Scarce seemèd there to be.

O sweeter than the marriage-feast,
'Tis sweeter far to me,
To walk together to the kirk
With a goodly company!—

To walk together to the kirk,
And all together pray,
While each to his great Father bends,
Old men, and babes, and loving friends
And youths and maidens gay!

Farewell, farewell! but this I tell
To thee, thou Wedding-Guest!
He prayeth well, who loveth well
Both man and bird and beast.

He prayeth best, who loveth best
All things both great and small;
For the dear God who loveth us,
He made and loveth all."—

The Mariner, whose eye is bright,
Whose beard with age is hoar,
Is gone: and now the Wedding-Guest
Turned from the bridegroom's door.

He went like one that hath been stunned,
And is of sense forlorn:
A sadder and a wiser man,
He rose the morrow morn.

THE NEXT POEMS ARE ON PAGE 4029.

THE PRESIDENTS OF THE UNITED STATES

A SHORT ACCOUNT OF THEIR LIVES AND ADMINISTRATIONS

GEORGE WASHINGTON. First President. 1789–1797.

George Washington was born on February 22, 1732, in Westmoreland County, Virginia. He was the son of Augustine Washington, a well-to-do planter, and of Martha Ball. He had comparatively little schooling. At the age of sixteen he became a surveyor on the Virginia estate of Lord Fairfax; later he became a public surveyor. In the meantime he gave a good deal of time to the study of military tactics.

In 1752 Lieutenant-Governor Dinwiddie gave him a commission as major in the Virginia militia. Washington served in the French and Indian War until 1758, when fighting ceased in the South and West. In the following year he married Martha Dandridge Custis, a widow.

Washington took the side of the colonists in the disputes with England. He was chosen as a delegate to the First Continental Congress in 1774 and to the Second in 1775. After fighting broke out between England and the American colonies, Washington was made commander-in-chief of the Continental armies. He took command on July 3, 1775, and served until the end of the war, in 1783.

After the war Washington retired to his estate of Mount Vernon, in Virginia. He was chosen in 1787 to preside over the convention that framed the Constitution. In 1788 he was elected first president of the United States; he took office on April 30, 1789.

Washington's chief task was to put the new government into working condition. He set up executive departments and named able men for his Cabinet, including Thomas Jefferson as Secretary of State and Alexander Hamilton as Secretary of the Treasury.

The financial position of the country was improved. Taxes were provided to bring in necessary revenue; a national bank was set up; native industries were safeguarded by a protective tariff. The federal government strengthened public confidence by taking over all the debts of the different states.

In 1791 Washington called out an army of 15,000 militia to put down the Whiskey Rebellion—a revolt against tax collectors in the western counties of Pennsylvania. Thus the President showed that the government meant to enforce the laws.

Trouble with England was avoided by the Jay Treaty of 1794; it was so called because one of the signers was John Jay, chief justice of the Supreme Court. There were serious disputes with France. She wanted the United States to help in her war against England and other European powers, but Washington refused.

North Carolina and Rhode Island, which at first had refused to accept the Constitution, did so in the first years of Washington's administration. The number of states in the Union was increased to sixteen by the addition of Vermont (1791), Kentucky (1792) and Tennessee (1796).

There were no political parties in Washington's first administration, but in his second two parties sprang up—the Federalists and the Republicans (later known as the Democrats). The Federalists were in favor of a strong central government and believed that the poorer classes should not have political power. The Republicans wished to give more power to the states, and also held that all the people should have a share in the government. Hamilton led the Federalists; Jefferson, the Republicans.

Washington refused to run for a third term. In 1797 he retired to his beloved Mount Vernon, where he spent the rest of his days. He died on December 14, 1799.

JOHN ADAMS. Federalist. Second President. 1797–1801.

John Adams was born on the thirtieth of October, 1735, in what is now Quincy, Massachusetts; he was the son of John Adams and Susanna Boylston. He was graduated from Harvard in 1755, and taught school for a time. Then he turned to the study of the law. He began practice in 1758 and soon became a leader at the bar and in public life. In 1764 he married Abigail Smith. They had five children; one of them, John Quincy Adams, became the sixth president.

Adams championed the American colonists in their quarrels with England. He was a member of the First and Second Continental Congresses, and it was he who proposed that Washington should be named commander-in-chief of the Continental Army. Adams withdrew from the Continental Congress in 1777.

Thereafter he served his country in various missions in France and Holland.

He was elected vice-president in November, 1788, and served two terms (1789-1797). In 1796 he was elected president, defeating Thomas Jefferson by the narrow margin of three electoral votes.

In Adams' administration there was much trouble with France, who was angry because the United States had not helped her against England. The French seized several American ships and threatened to continue this practice unless the Americans bribed some of the French ministers. In 1798 fighting broke out between American and French warships. However, war was never officially declared, and the fighting did not last very long.

In their efforts to get American help in the war with England, French agents made many appeals to American citizens; they did not hesitate to attack the American government. Congress sought to check the activities of foreign agents by passing the Alien and Sedition Acts of 1798. These measures were directed not only against foreigners who tried to stir up trouble, but also against all persons who spoke or wrote against the government. The Alien and Sedition Acts were very unpopular and caused the Adams administration to lose favor with the people.

Adams lost, in the election of 1800. His later years were spent in his home state of Massachusetts, where he always took great interest in public affairs. He died in what is now Quincy, Massachusetts, on July 4, 1826.

THOMAS JEFFERSON. Republican. Third President. 1801–1809.

Thomas Jefferson was born at Shadwell, Virginia, on April 13, 1743; he was the son of Peter Jefferson and Jane Randolph. He attended William and Mary College from 1760 to 1762 and then began the study of law. He was admitted to the bar in 1767 and won great success as a lawyer.

In 1769 Jefferson began his public career by becoming a member of the Virginia House of Burgesses, the legislative body of the colony. In 1772 he married Martha Skelton, a charming young widow. They made their home at Monticello, a mansion which Jefferson had built in 1770.

Jefferson was a delegate to the Virginia Conventions of 1774 and 1775, which met to discuss measures to be taken against the English government. In 1775 he became a member of the Second Continental Congress. In the following year he became the chairman of the committee named to draw up the Declaration of Independence. This famous document was chiefly his work.

Jefferson returned to his native state in 1776 and entered the state legislature. He served as governor of Virginia from 1779 to 1781. During his term of office he was almost captured by an English army which had invaded the state.

He went to France as an American diplomatic agent in 1784; in the following year he succeeded Benjamin Franklin as minister to the French court. He returned to America in 1789 to become Secretary of State under Washington. He resigned his office in 1793 and spent the next three years in retirement at Monticello.

Jefferson opposed John Adams in the presidential election of 1796. Adams had most votes. Jefferson came next, and so he became vice-president, according to a section of the Constitution which was amended in 1804. In 1800 Jefferson ran again against Adams and this time he won the election.

Jefferson's administration was an eventful one. In 1803 Ohio was admitted to the Union. In the same year the territory known as Louisiana was purchased from France for $15,000,000. It extended westward from the Mississippi to the Rockies; in the course of time thirteen states were carved out from it wholly or in part. Louisiana was explored by the expedition of Lewis and Clarke in 1804-1806.

The small navy of the United States went into action against the pirates of Tripoli, who for years had made American ships pay tribute. The pirates had to sue for peace in 1805. Thereafter they seldom molested the ships of the United States.

England was at war with France much of the time while Jefferson was in office. Each of these countries tried to prevent the United States from sending goods to the other. They treated this country very badly, seizing merchantmen and confiscating cargoes. To bring both England and France to their senses, Jefferson had Congress pass the Embargo Act of 1807, forbidding American ships to trade with foreign countries.

In March, 1809, Jefferson retired from the presidency; he spent the remaining years of his life at Monticello. He died on July 4, 1826, on the same day as his old political foe, John Adams.

JAMES MADISON. Republican. Fourth President. 1809–1817.

James Madison was born at Port Conway, in Virginia, on March 16, 1751; he was the son of James Madison and Nelly Conway.

He went to Princeton College and was graduated in 1771. He worked as a tutor for a time; he also continued his studies, particularly in theology and law.

Madison served in the Virginia House of Burgesses and in the Second Continental Congress. He was an influential member of the convention that drew up the Constitution of the United States. He believed in a strong central government; his views were reflected in the "Virginia plan" which served as the basis of the Constitution.

He was elected as a representative in the first Congress, taking his seat in April, 1789. While in Congress, he changed his political views; he became a champion of states' rights. He now joined the Republican party, led by Jefferson. In 1794 he married Dolly Payne Todd, a widow. As Dolly Madison, she became one of the most famous ladies of the White House. Madison finally retired from Congress in the year 1797.

Madison became Secretary of State under Jefferson in 1801, and enjoyed the complete confidence of the President. When Madison ran for the presidency in 1808, he had Jefferson's support, and he won by a wide margin. He served two terms, from 1809 to 1817.

Madison's first administration was a troubled one, for both England and France continued to molest American shipping. England was the worse offender, because she had the larger navy. Like Jefferson, Madison was opposed to war; but the country as a whole demanded action. On June 18, 1812, war was declared against England.

Though the American navy was small, its ships were good and its seamen were brave; a number of British warships were defeated in fair fight. However, the American land forces did not make a very good showing on the whole. It was fortunate for the United States that England was too busy with fighting in Europe to send over strong forces to this continent. On December 24, 1814, a treaty of peace was signed at Ghent. The news of peace did not reach the United States in time to prevent a last big battle from being fought at New Orleans on January 8, 1815. It resulted in the greatest American victory of the war.

The first Bank of the United States came to an end in 1811, and another was chartered in 1816. Two new states, Louisiana (1812) and Indiana (1816), were added to the Union while Madison was president.

In 1817 Madison withdrew from public life and settled down on his estate of Montpelier, in Virginia. He died on June 28, 1836.

JAMES MONROE. **Republican. Fifth President. 1817–1825.**

James Monroe was born in Westmoreland County, Virginia, on April 28, 1758. His parents were Spence Monroe and Eliza Jones. He attended William and Mary College, but his studies were cut short by the Revolutionary War. In 1776 he became a lieutenant in a Virginia regiment. He distinguished himself as an officer, rising to the rank of lieutenant colonel.

In 1780 he retired from the army and began the study of law under Thomas Jefferson, who was then governor of Virginia. Monroe was elected to the state legislature in 1782; in the following year he became a member of the Congress of the Confederation, which succeeded the Continental Congress. In 1786 he married Elizabeth Kortwright.

Monroe served as minister to France from 1794 to 1796. In 1799 he was elected governor of Virginia. He occupied this post until 1803, when he was sent to France as a special envoy by President Jefferson. He helped Robert L. Livingston, American minister to France, negotiate the Louisiana Purchase. (See our life of Jefferson, in this article.) Monroe became governor of Virginia again in 1811. He resigned in the same year in order to become Secretary of State under James Madison. He served in that post until 1817.

Monroe was elected president on the Republican ticket in 1816. He came into office just as the country was recovering from the effects of the War of 1812. In the following years the young republic advanced by leaps and bounds. Florida was purchased from Spain in 1819, and it became a United States territory in 1822. Five new states—Mississippi (1817), Illinois (1818), Alabama (1819), Maine (1820) and Missouri (1821)—were added to the Union.

The Republican party had very little opposition during the greater part of Monroe's stay in office, and so this period has sometimes been called the "era of good feeling." When Monroe sought re-election in 1820, he was the only candidate; he received the votes of all the electors but one.

The so-called "era of good feeling" was marked by a serious dispute between the North and the South. By 1820 there were very few slaves north of Maryland, while slaves were used in increasing numbers in the plantations of the South. The two parts of the country, North and South, disagreed on the slavery question. When it was pro-

posed to let Missouri enter the Union as a slave state, the North protested bitterly. In 1821 a compromise was arranged. Missouri was admitted as a slave state; but slavery was prohibited in the Louisiana territory north of Latitude 36 degrees, 40 minutes.

In 1823 President Monroe sent a message, which was to become famous, to Congress. In it he said that the United States did not want any European power to set up new colonies in the Western Hemisphere or to interfere with the republics of South and Central America. Such acts would be considered as "dangerous to our peace and safety." This statement of policy became known as the Monroe Doctrine.

Monroe retired to private life in 1825 and took up his residence in Loudoun County, Virginia. He was in financial difficulties in his later years; he was forced to ask Congress to repay him for the money he had spent out of his own pocket while in public service. Congress voted him the sum of $30,000. Monroe died in New York on July 4, 1831.

JOHN QUINCY ADAMS. National Republican. Sixth President. 1825–1829.

John Quincy Adams was born in Braintree, in Massachusetts, on July 11, 1767; he was the son of John Adams, the second president, and of Abigail Smith. He accompanied his father to France in 1777 and went to school in that country and in Holland. He returned to America and was graduated from Harvard in 1788. He then studied law, and in 1791 he was admitted to the bar. In 1794 Washington appointed him minister to The Hague. Three years later Adams married Louisa Catherine Johnson.

He entered the United States Senate in 1803. As a senator he generally supported the Jefferson Administration; he broke with his own party, the Federalists. In 1808 he was named minister to Russia, and he remained in this post for four years. In 1814 he helped to draw up the Treaty of Ghent which ended the War of 1812. He was appointed minister to England in the following year. He served as Secretary of State under James Monroe from 1817 to 1825.

In 1824 Adams was a candidate for the presidency, running against three other men. Since none of the candidates received a majority of the electoral votes, it became the duty of the House of Representatives to select the president and Adams was chosen.

President Adams and Congress could not agree and very few important laws were passed during his administration. At this time the Republican party, which had often been called the Democratic-Republican, began to be known as the Democratic party. It officially became the Democratic party in 1844, and has kept the name ever since.

While Adams was president the Erie Canal from Albany, on the Hudson River, to Buffalo, on Lake Erie, was completed (1825). It made travel to the West far cheaper and easier in every way; and it helped to build up many cities and towns along its route.

In 1828 Adams was a candidate for reelection; he was defeated by Andrew Jackson. Yet he was not through with public life. In 1831 he was elected to the House of Representatives from a Massachusetts district and he remained in Congress until his death, seventeen years later. He made his influence felt; he was one of the most effective opponents of slavery in Congress. He died on February 23, 1848, of a stroke of apoplexy which he had suffered on the floor of the House.

ANDREW JACKSON. Democrat. Seventh President. 1829–1837

Andrew Jackson was born on March 15, 1767, in the old Waxhaw settlement, near the border line between North and South Carolina. He was the son of Andrew Jackson and Elizabeth Hutchison. Because of his family's poverty, he received very little schooling. He fought against the English in the Revolutionary War, though a mere boy, and was taken prisoner.

At the age of seventeen he entered a law office at Salisbury, North Carolina, and was admitted to the bar in 1787. He began to practice law in Nashville, Tennessee, in the following year. In 1789 he became public prosecutor for a frontier district made up of three Tennessee counties. In 1791 he married Rachael Donelson Robards.

Jackson entered the House of Representatives in 1796; in the following year he was chosen senator to fill a vacancy. He resigned in 1798 to become a judge of the Supreme Court of Tennessee, a post which he held until 1804. In the meantime he had been named major general of militia for the western district of Tennessee (1802). From 1804 to 1811 he engaged in various business and farming enterprises.

When war with England broke out in 1812, Jackson offered his services. In March, 1814, he defeated the Creek Indians at Horseshoe Bend. He was the leader of the American forces in the Battle of New Orleans, in which the British were utterly defeated (January 8, 1815).

In 1817 Jackson headed an army which invaded Florida, then held by Spain. The object of the expedition was to punish the fierce Seminole Indians, who had crossed the frontier and had massacred Americans. Jackson drove back the Seminoles and occupied their territory. After Florida was purchased from Spain, Jackson became its governor (1821).

He was elected to the United States Senate in 1823. In the following year he was an unsuccessful candidate for the presidency. He ran again in 1828, and this time he won easily. He served two terms (1829-1837).

He turned out many government officials who had served under John Quincy Adams, and he put his own followers in their place. Thus he introduced the "spoils system" in American politics: that is, public offices came to be considered as the spoils, or plunder, of the successful party in an election.

In 1832 Congress passed a law increasing the tax on all cotton and woolen goods imported from abroad. Southerners did not like this measure; they claimed that they could clothe their slaves much more cheaply on imported materials than on cloth made by Northern manufacturers. South Carolina declared that the new tax law would not be enforced in that state. Serious trouble was prevented only by the firmness of President Jackson and the efforts of Henry Clay, "the great compromiser."

President Jackson opposed the United States Bank and helped to destroy it by refusing to grant it a new charter. The surplus money in the treasury of the United States was distributed to the states.

During Jackson's stay in office two new states were added to the Union—Arkansas (1836) and Michigan (1837). The country continued to grow at a rapid rate. The railroads, first established in this administration, brought people to settle many new areas and to build up lightly inhabited areas.

The opponents of President Jackson began to call themselves Whigs during his second term of office. They formed a strong opposition party as time went on.

After leaving the White House in 1837, Jackson retired to the Hermitage, his home in Tennessee, and there he spent the rest of his life. He died on June 8, 1845.

MARTIN VAN BUREN. Democrat. Eighth President. 1837–1841.

Martin Van Buren was born at Kinderhook, New York, on the fifth of December, 1782. He was the son of Abraham Van Buren and Mary Hoes. He attended the village school and studied at Kinderhook Academy. At the age of fourteen he entered a law office, and was admitted to the bar in 1803. In 1807 he married Hannah Hoes, his cousin.

Van Buren entered public life in 1808 when he became a surrogate (a judge presiding over the settling of inheritances) in Columbia County. Later he served as state senator and state attorney general. He was elected United States senator in 1820 and was re-elected in 1826. He resigned his seat in 1828 to become governor of New York.

Van Buren became United States Secretary of State under Jackson in 1829. In 1832 he was elected vice-president on the Democratic ticket headed by Jackson. He was elected to the presidency in 1836 over his Whig opponent, William Henry Harrison.

In 1837, the first year of Van Buren's administration, there was a serious financial panic. Van Buren was not to blame for this crisis; and he did much to repair the damage. In the year 1840 he pushed through Congress a bill providing that only public officers should manage the collection, safekeeping and transfer of public moneys. This measure prevented bankers from speculating with funds belonging to the Treasury.

Van Buren was a candidate for re-election in 1840, but was defeated by Harrison. In 1848 he was the unsuccessful presidential candidate of the Free Soil party. He spent his last years at Kinderhook, his old home, where he died on July 24, 1862.

WILLIAM HENRY HARRISON. Whig. Ninth President. March-April, 1841.

William Henry Harrison was born in Berkeley, a small town in Virginia, on the 9th of February, 1773. His father, Benjamin Harrison, was a signer of the Declaration of Independence; his mother was Elizabeth Bassett. He attended Hampden-Sydney College and later studied medicine. He did not complete his medical studies, but decided to accept a commission in the Army. Soon afterward he married Anna Symnes. They had ten children.

After taking part in several expeditions against the Indians, Harrison resigned from the Army in 1797. In that year he became secretary of the Northwest Territory. Later President John Adams appointed him governor of the Indian Territory; he continued to serve as governor until 1812. In 1811 he led an expedition against the hostile Indians of northwestern Indiana, and defeated them in the Battle of Tippecanoe.

When the War of 1812 broke out, Harri-

son was appointed to the chief command of the Northwest. He was one of the few successful American generals in the war. His victory over the English and their Indian allies near the river Thames, in Ontario, Canada (October, 1813), ended the English threat in the area of the Great Lakes.

In the years that followed Harrison was a member of the United States House of Representatives, then United States senator, and minister to Colombia. In 1840 he was the Whig candidate for president; his running mate was John Tyler. Amid shouts of "Tippecanoe and Tyler too," the old general was elected by 294 electoral votes to 60. He caught cold on the day of his inauguration and died on April 4, 1841.

JOHN TYLER. Whig. Tenth President. 1841–1845.

John Tyler was born at Greenway, Virginia, on March 20, 1790. He was the son of John Tyler and Mary Armistead. After he was graduated from William and Mary College in 1807, he took up the study of the law. He was admitted to the bar in 1819. Two years later he entered public life when he was elected to the state legislature. In 1813 he married Letitia Christian.

Tyler served as a captain of militia in the War of 1812. In November, 1816, he was selected to fill a vacancy in the United States House of Representatives. He was governor of Virginia from 1825 to 1827; in the latter year he entered the United States Senate. At first he supported President Jackson, but he broke with the administration after a time and became an influential member of the Whig opposition.

Tyler was an unsuccessful candidate for vice-president in 1836. In 1840 he was nominated for the vice-presidency by the Whigs as the running mate of William Henry Harrison, and he was elected. Harrison died a month after his inauguration, and Tyler became president. His first wife died in 1841; in 1844 he married Julia Gardner.

The President quarreled with his Whig supporters and soon found himself a national leader without a party. As a result he failed to accomplish much in his administration.

The Webster-Ashburton Treaty, signed in 1842, settled the boundary between Maine and Canada. In 1844 a telegraph line was constructed from Washington to Baltimore. This marked a new era in the history of the sending of messages. Florida was admitted to the Union on March 3, 1845, the day before Tyler left office.

From 1845 to the outbreak of the Civil War, Tyler held no public office. He favored the secession of Virginia in 1861. In May of that year he was elected a member of the provisional (temporary) Congress of the Confederate States. Several months later he was elected to the permanent Congress, but he died at Richmond on January 18, 1862, before taking his seat.

JAMES KNOX POLK. Democrat. Eleventh President. 1845–1849.

James Knox Polk was born in Mecklenburg County, North Carolina, on the second of November, 1795; his parents were Samuel Polk and Jane Knox. He was graduated from the University of North Carolina in 1818. He then settled in Tennessee where he studied law; he was admitted to the bar in 1820.

Polk became a member of the House of Representatives in 1823. In the following year he married Sarah Childress. Polk remained in the House for fourteen years, winning great distinction; he served two terms as speaker. He was governor of Tennessee from 1839 to 1841, but was defeated for re-election in 1841 and again in 1843.

In 1844 he was the Democratic candidate for president, and defeated his Whig opponent, Henry Clay. When he came into office, both Great Britain and the United States were claiming the great Oregon Territory in the Northwest. In 1846 the two countries agreed to divide the territory between them; the 49th degree of latitude was to be the boundary.

The independent republic of Texas was admitted to the Union as a state, at its request, in December, 1845. Texas had claimed a strip of land which the Mexicans said belonged to them. The United States took over the claim of Texas, and in 1846 this led to war with Mexico. The Mexicans fought stubbornly, but the American armies won one battle after another. When peace was signed in 1848, Mexico had to give up an immense area. This included not only the disputed territory, but also what is now California, Utah, Nevada and parts of New Mexico, Arizona, Colorado and Wyoming. The United States agreed to pay Mexico $15,000,000 for this land.

In addition to Texas, Iowa (1846) and Wisconsin (1848) joined the Union in Polk's administration. In 1848 gold was discovered in California. Crowds of fortune-hunters flocked to that part of the West, and the section was rapidly settled.

Polk did not seek a second term. He died at Nashville, Tennessee, on June 15, 1849.

ZACHARY TAYLOR. Whig. Twelfth President. 1849–1850.

Zachary Taylor was born in Orange County, Virginia, on the 24th of November, 1784. His father, Richard Taylor, fought in the Revolutionary War; his mother was Sarah Strother. Zachary's family moved to Kentucky soon after his birth. He had very little schooling, but from an early age took a great interest in military matters. In 1808 he entered the United States Army, receiving a commission as second lieutenant. He married Margaret Smith in 1810.

Taylor served with distinction in the War of 1812. He left the service for a time after the war, but re-entered the Army in 1816. For a time has was stationed at different frontier posts. In 1837 he defeated the Seminole Indians of Florida at Okeechobee. He spent the next four years in Florida. Then he was given the command of the First Department of the Army, with headquarters at Fort Jessup, Louisiana.

When war with Mexico broke out in 1846, Taylor was one of America's foremost generals. He defeated the Mexicans in a number of battles, including Palo Alto, Resaca de la Palma, Matamoras, Monterrey and Buena Vista, and he became a national hero. The Whigs decided to take advantage of his popularity. Although he knew nothing about politics and had never even voted, he was nominated for the presidency at the Whig convention of 1848. In the election that followed he defeated Lewis Cass, the Democratic candidate.

Not long after Taylor's inauguration California asked to come into the Union as a free state. The North hailed the move; the South bitterly opposed it. President Taylor, although he was a slaveholder himself, favored the admission of California as a free state. But before the dispute could be settled, the President died suddenly, on July 9, 1850. He was succeeded by his vice-president, Millard Fillmore.

MILLARD FILLMORE. Whig. Thirteenth President. 1850–1853.

Millard Fillmore was born in Cayuga County, in New York, on January 7, 1800; he was the son of Nathaniel Fillmore and Phoebe Millard. He had a rather limited education. He studied law at Buffalo and began the practice of the legal profession in the neighboring town of Aurora. In 1826 he married Abigail Powers.

Fillmore moved to Buffalo in 1830 and became very successful as a lawyer. In 1832 he entered the United States House of Representatives as a follower of Henry Clay. He became the comptroller of New York State in 1847. (A state comptroller is an official who checks the sums spent by the state.) In the following year he was nominated for the vice-presidency by the Whigs, running on the ticket headed by Zachary Taylor; and he was elected with Taylor.

On July 9, 1850, President Taylor suddenly died, and Fillmore became president. With Fillmore's support the leaders of the North and South adopted a compromise which, it was hoped, would end the slavery dispute. Under the terms of this Compromise of 1850, as it was called, (1) California entered the Union as a free state; (2) the slave trade was forbidden in the District of Columbia; (3) Congress passed a fugitive slave law enabling slave-owners to seize their runaway slaves in the North; (4) slavery was permitted in the newly organized territories of New Mexico and Utah.

The Compromise of 1850 did not bring peace. The slavery dispute became more bitter than ever. Harriet Beecher Stowe helped to fan the flames with her famous book UNCLE TOM'S CABIN, published in 1852.

The Whigs refused to nominate Fillmore for a second term in 1852. He ran for the presidency in 1856 on the American, or Know-Nothing, party ticket, but received the electoral votes of only one state. In 1858, his first wife having died, he married Caroline Carmichael McIntosh. He died in Buffalo on March 8, 1874.

FRANKLIN PIERCE. Democrat. Fourteenth President. 1853–1857.

Franklin Pierce was born at Hillsboro, in New Hampshire, on the 23rd of November, 1804; he was the son of Benjamin Pierce and Anna Kendrick. He was graduated from Bowdoin College, Maine, in 1824; Longfellow and Hawthorne were among his classmates. For the next three years he studied law, and was admitted to the bar in 1827.

He entered politics almost immediately. He served in the state legislature for several years; in 1833 he became a member of the House of Representatives and a firm supporter of President Jackson. He married Jane Appleton in 1834. Pierce entered the United States Senate in 1837; he was the youngest member when he took his seat. He resigned in 1842 to accept the post of federal district attorney of New Hampshire.

He served in the Mexican War of 1846-48, rising to the rank of brigadier general of volunteers. Afterward he engaged in the

practice of law. In 1852 he was nominated for the presidency by the Democratic convention. He defeated the Whig candidate, General Winfield Scott, in November.

It became clear early in Pierce's administration that the Compromise of 1850 was not going to prove effective. The slavery dispute continued to trouble the peace of the country. In 1854 Senator Stephen A. Douglas of Illinois pushed his Kansas-Nebraska Bill through Congress. This measure provided that the people of the territories of Kansas and Nebraska were to be free to accept or abolish slavery as they saw fit. The bill set aside the Missouri Compromise of 1821, which had barred slavery in this area. Kansas now became a battlefield. Settlers from the North wanted to keep out slavery; those from the South were determined to own slaves. The two parties came to blows again and again; the region became known as "Bleeding Kansas."

In 1854 the United States paid Mexico $10,000,000 for a big territory west of the Rio Grande River. This was called the Gadsden purchase, after James Gadsden, United States minister to Mexico. In the same year the United States and Japan signed a treaty setting up diplomatic and trade relations between the two countries.

In Pierce's administration the anti-slavery men organized a new party—the Republican. A group of men who were against admitting foreigners to the United States founded the American, or Know-Nothing, party.

After retiring from the presidency, Pierce traveled in Europe for three years, returning home in 1860. He was opposed to the methods of certain anti-slavery groups, but supported the North when civil war broke out in 1861. He died at Concord, New Hampshire, on October 8, 1869.

JAMES BUCHANAN. Democrat. Fifteenth President. 1857–1861.

James Buchanan, born not far from Mercersburg, Pennsylvania, on the 23rd of April, 1791, was the son of James Buchanan and Elizabeth Speer. He was graduated from Dickinson College in 1810. He studied law in an office in Lancaster, Pennsylvania, and was admitted to the bar in 1812. Not long afterward his fiancée died just before the time set for their wedding. Buchanan was deeply moved by his loss; he never married.

He practiced the law very little; almost all of his mature life was spent in public service. After two years in the Pennsylvania state legislature, he was elected to the United States House of Representatives in 1821, and served in that body for ten years. He was minister to Russia from 1832 to 1833, United States Senator from 1834 to 1845, Secretary of State under Polk from 1845 to 1849 and minister to England from 1853 to 1856. In 1856 he was elected to the presidency on the Democratic ticket.

In Buchanan's administration the discussion over slavery became more bitter than ever. In its Dred Scott Decision of 1857, the Supreme Court declared that Negroes could not become citizens and that Congress could not keep slavery out of the territories. Many people in the North refused to return runaway slaves to their owners, but helped to hide them or send them on to Canada.

John Brown, who had fought against slavery in Kansas, made a raid upon the United States arsenal at Harper's Ferry, Virginia, in June, 1859. He captured the arsenal, with its abundant supplies of arms; and he tried to excite the slaves to rise against their masters. Brown was captured, tried and hanged by the state of Virginia.

The Democratic party split into a Northern and a Southern branch. The first nominated Stephen A. Douglas in 1860 for the presidency; the second, John C. Breckenridge. The Constitutional Union party nominated John Bell, while Abraham Lincoln was the Republican candidate. Lincoln was elected in November, 1860, although he did not have a majority of the popular vote.

South Carolina had threatened to secede, or withdraw, from the Union if the Republicans elected their candidate; she carried out her threat in December, 1860. Before Buchanan's term of office came to an end, six other Southern states had followed South Carolina out of the Union. They set up a separate government called the Confederate States of America. President Buchanan did not think that these states had the right to secede, but he did not think, either, that they should be forced to stay in the Union.

Three new states were admitted to the Union during Buchanan's term of office. These were Minnesota (1858), Oregon (1859) and Kansas (1861).

After Lincoln's inauguration, Buchanan announced his support of the new president. He spent his last years writing a defense of his administration. He died at Wheatland, Pennsylvania, on June 1, 1868.

ABRAHAM LINCOLN. Republican. Sixteenth President. 1861–1865.

Abraham Lincoln was born in a humble log cabin in Hardin County, Kentucky, on February 12, 1809. He was the son of

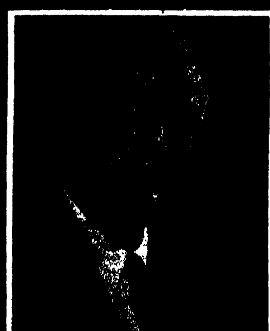
EXECUTIVES OF THE UNITED STATES

HARRY S TRUMAN, of Missouri, 1884. Thirty-second President, 1945. Democrat. © Pach Bros.

THE CAPITOL, SEAT OF THE GOVERNMENT © H. H. Rideout

ALBEN W. BARKLEY, of Kentucky, 1877. Vice President in Truman's second term

JOHN N. GARNER, of Texas, 1869. Vice President during F. D. Roosevelt's first two terms



FRANKLIN D. ROOSEVELT, of New York, 1882-1945. Thirty-first President, 1933-1945. Democrat

HENRY A. WALLACE, of Iowa, 1888. Vice President during F. D. Roosevelt's third term

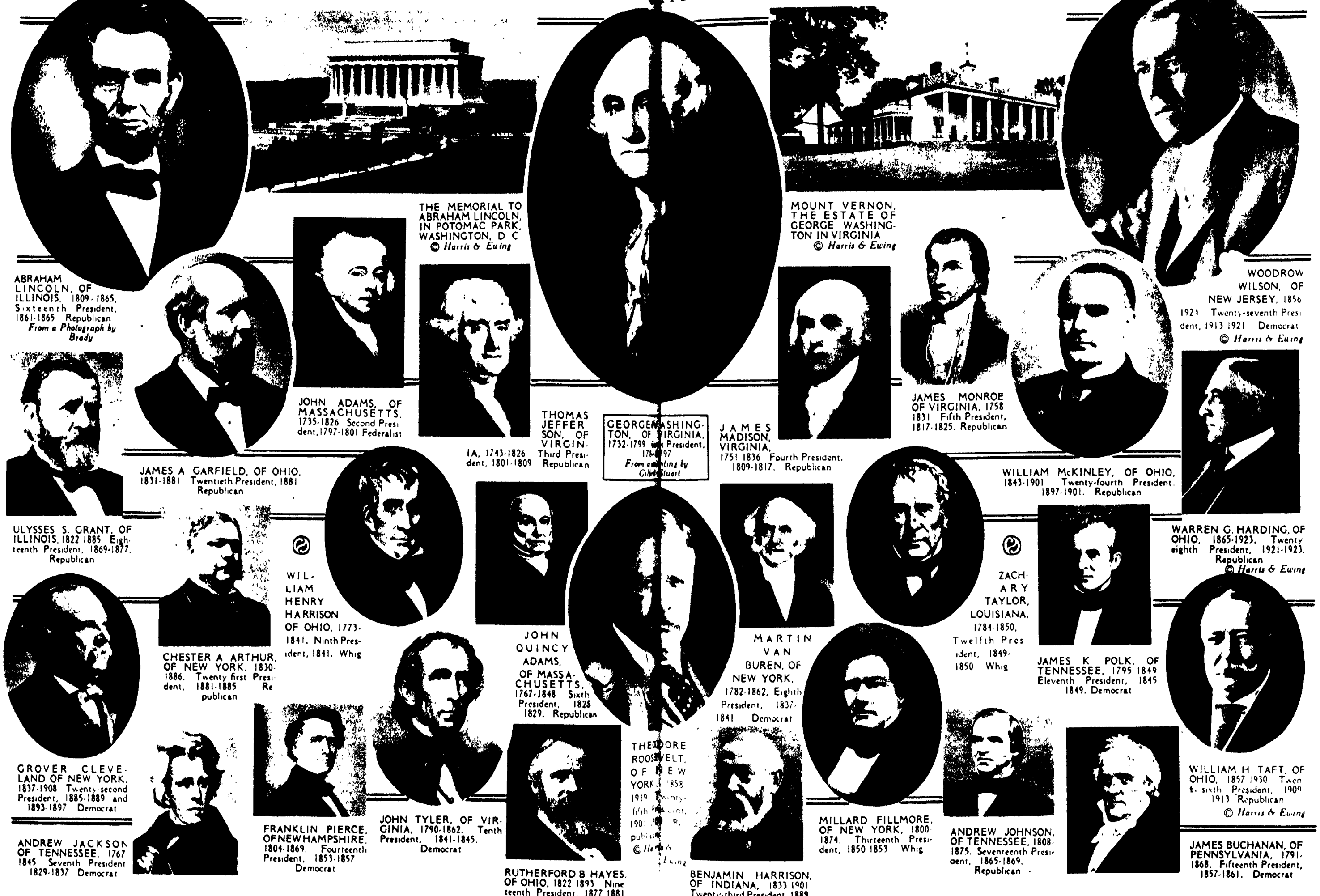
CALVIN COOLIDGE, [illegible] 1872-1933. [illegible] President, 1923-1929. Republican © Pach Bros.

[illegible] MONUMENT © H. H. [illegible]

HERBERT [illegible] HOOVER, [illegible] © Pach Bros.

ON THIS AND THE FOLLOWING PAGES WILL BE FOUND THE PICTURE OF EVERY MAN WHO HAS SERVED AS PRESIDENT OR VICE-PRESIDENT OF THE UNITED STATES

THE TWENTY-EIGHT PRESIDENTS WHO PRECEDED CALVIN COOLIDGE



ABRAHAM LINCOLN, OF ILLINOIS. 1809-1865. Sixteenth President, 1861-1865 Republican *From a Photograph by Brady*

THE MEMORIAL TO ABRAHAM LINCOLN, IN POTOMAC PARK, WASHINGTON, D C *© Harris & Ewing*

GEORGE WASHINGTON, OF VIRGINIA, 1732-1799 First President, 1789-1797 *From a painting by Gilbert Stuart*

MOUNT VERNON, THE ESTATE OF GEORGE WASHINGTON IN VIRGINIA *© Harris & Ewing*

WOODROW WILSON, OF NEW JERSEY, 1856 1921 Twenty-seventh President, 1913 1921 Democrat *© Harris & Ewing*

JOHN ADAMS, OF MASSACHUSETTS, 1735-1826 Second President, 1797-1801 Federalist

THOMAS JEFFERSON, OF VIRGINIA, 1743-1826 Third President, 1801-1809 Republican

JAMES MADISON, VIRGINIA, 1751 1836 Fourth President, 1809-1817. Republican

JAMES MONROE OF VIRGINIA, 1758 1831 Fifth President, 1817-1825. Republican

JAMES A GARFIELD, OF OHIO, 1831-1881 Twentieth President, 1881 Republican

WILLIAM McKINLEY, OF OHIO, 1843-1901 Twenty-fourth President, 1897-1901. Republican

ULYSSES S. GRANT, OF ILLINOIS, 1822 1885 Eighteenth President, 1869-1877. Republican

WARREN G. HARDING, OF OHIO, 1865-1923. Twenty eighth President, 1921-1923. Republican *© Harris & Ewing*

WILLIAM HENRY HARRISON OF OHIO, 1773-1841. Ninth President, 1841. Whig

ZACHARY TAYLOR, LOUISIANA, 1784-1850, Twelfth President, 1849-1850 Whig

CHESTER A ARTHUR, OF NEW YORK, 1830-1886. Twenty first President, 1881-1885. Republican

JOHN QUINCY ADAMS, OF MASSACHUSETTS, 1767-1848 Sixth President, 1825 1829. Republican

MARTIN VAN BUREN, OF NEW YORK, 1782-1862, Eighth President, 1837-1841 Democrat

JAMES K POLK, OF TENNESSEE, 1795 1849 Eleventh President, 1845 1849. Democrat

GROVER CLEVELAND OF NEW YORK, 1837-1908 Twenty-second President, 1885-1889 and 1893-1897 Democrat

THEODORE ROOSEVELT, OF NEW YORK 1858 1919 Twenty-fifth President, 1901-1909 Republican *© Harris & Ewing*

WILLIAM H TAFT, OF OHIO, 1857 1930 Twenty-sixth President, 1909 1913 Republican *© Harris & Ewing*

ANDREW JACKSON OF TENNESSEE, 1767 1845 Seventh President 1829-1837 Democrat

FRANKLIN PIERCE, OF NEW HAMPSHIRE, 1804-1869. Fourteenth President, 1853-1857 Democrat

JOHN TYLER, OF VIRGINIA, 1790-1862. Tenth President, 1841-1845. Democrat

RUTHERFORD B HAYES, OF OHIO, 1822 1893 Nineteenth President, 1877 1881 Republican

BENJAMIN HARRISON, OF INDIANA, 1833 1901 Twenty-third President, 1889 1893 Republican

MILLARD FILLMORE, OF NEW YORK, 1800-1874. Thirteenth President, 1850 1853 Whig

ANDREW JOHNSON, OF TENNESSEE, 1808-1875. Seventeenth President, 1865-1869. Republican

JAMES BUCHANAN, OF PENNSYLVANIA, 1791-1868. Fifteenth President, 1857-1861. Democrat

NOTE The following presidents were born in the states named here, not in the states from which they were elected those given above Andrew Jackson, North Carolina William Henry Harrison, Virginia James K. Polk, North Carolina. Zachary Taylor, Virginia. Abraham Lincoln, Kentucky; U. S. Grant, Ohio, Chester A. Arthur, Vermont. Grover Cleveland, New Jersey. Andrew Johnson, North Carolina. Benjamin Harrison, Ohio. Woodrow Wilson, Virginia.

Courtesy New York Evening Post

MEN WHO WERE VICE-PRESIDENTS

The ten Vice-Presidents who became Presidents are shown on the preceding pages

AARON BURR, of New York, 1756-1836 Vice-President for Thomas Jefferson's first term

GEORGE CLINTON, of New York, 1739-1812. Vice-President during Jefferson's second term and part of Madison's first term

DANIEL D TOMPKINS, of New York, 1774-1825. Vice-President throughout Monroe's two terms

JOHN C CALHOUN, of South Carolina, 1782-1850 Vice-President during the regime of John Quincy Adams and Jackson's first term

RICHARD M JOHNSON, of Kentucky, 1780 1850 Vice-President for Martin Van Buren

GEORGE M. DALLAS, of Pennsylvania. 1792 1864 Vice-President under James K Polk

ELBRIDGE GERRY, of Massachusetts, 1744-1814. Vice-President for one year of Madison's second term

CHARLES GATES DAWES, of Illinois, 1865. Vice-President, 1925-1929
© Harris & Ewing

CHARLES CURTIS, of Kansas, 1860-1936. Vice-President, 1929-1933
© Harris & Ewing

HENRY WILSON, of Massachusetts, 1812-1875 Vice-President during part of Grant's second term

WILLIAM A WHEELER of New York, 1819 1887 Vice-President during the Hayes administration

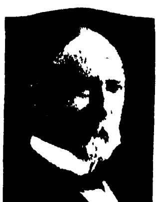
WILLIAM R KING, of Alabama, 1786-1853. Elected to the vice presidency under Franklin Pierce, he died before assuming duties

JOHN C BRECKINRIDGE, of Kentucky, 1821-1875 Vice-President for Buchanan

HANNIBAL HAMLIN, of Maine, 1809-1891. Vice-President during Lincoln's first administration

SCHUYLER COLFAX, of Indiana, 1823 1885 Vice-President for Grant's first term

THOMAS A HENDRICKS, of Indiana, 1819 1885 Vice-President less than one year during Cleveland's first term



CHARLES W FAIRBANKS, of Indiana, 1852 1918 Vice-President for Roosevelt
©Harris & Ewing

LEVI P MORTON of New York, 1824-1920. Vice-President during Harrison's term

GARRET A HOBART, of New Jersey, 1844 1899. Vice-President in McKinley's first term

JAMES S. SHERMAN, of New York, 1855-1912. Vice-President during part of Taft's administration

ADLAI E STEVENSON, of Illinois, 1835-1914. Vice President in second Cleveland term

THOMAS R MARSHALL, of Indiana, 1854 1925 Vice-President during Wilson's two terms

After Van Buren's election (1836), the only vice-presidents to be elected president were T. Roosevelt (1904), Coolidge (1924) and Truman (1948).

Thomas Lincoln and Nancy Hanks. The family was very poor, and he received but little schooling. After many wanderings, the family settled down in Illinois. Lincoln had to earn his own living at an early age; he worked as a clerk in New Salem, Illinois.

In 1832 Lincoln was elected captain of a company of volunteers in the Black Hawk War of 1832, but saw no fighting. He was elected to the legislature in 1834, and he served four years. In the meantime he studied law and was admitted to the bar in 1836. In 1842 he married Mary Todd.

Lincoln was elected to the United States House of Representatives in 1846, and served one term. After returning to Illinois, he devoted himself to the practice of law. In 1858 he was the Republican candidate for United States senator from Illinois. He engaged in a series of famous debates with his Democratic opponent, Stephen A. Douglas, over the slavery question. Douglas was elected, but Lincoln won great fame.

In 1860 he was elected to the presidency on the Republican ticket. As we pointed out in our life of Buchanan, South Carolina seceded in December, 1860, because a Republican had been elected president. By the time Lincoln was inaugurated, six other states—Georgia, Florida, Alabama, Mississippi, Louisiana and Texas—had followed the example of South Carolina. The seceding states had set up a separate government called the Confederate States of America.

Lincoln announced in his inaugural address that he intended to preserve the Union; and North and South drifted toward war. The Confederates brought on the struggle at last by firing on Fort Sumter, in Charleston Harbor, on April 12, 1861. Lincoln now called for 75,000 volunteers. Virginia seceded, followed by Arkansas and Tennessee; North Carolina also joined the Confederacy not long afterward.

The President devoted himself to the task of winning the war and saving the Union. The North suffered many defeats in the course of the four years of fighting. But the South was gradually enclosed in a ring of steel as Union armies kept up constant pressure and Union warships blockaded Southern ports. The Confederates launched a formidable invasion of the North in 1863, but it was turned back at Gettysburg in July. Thereafter the South was doomed.

President Lincoln was re-elected in 1864, and he turned with renewed confidence to the task of bringing the war to an end. The last crushing blow to the Confederacy was the surrender of Lee's army at Appomattox on April 9, 1865. This practically ended the struggle, though other Confederate forces remained in the field for a few weeks.

So the Union was restored. Two more states had been admitted in the course of the war. The western counties of Virginia had been opposed to secession. They formed a new state, West Virginia, which joined the Union in 1863. Nevada became a state in 1864.

On April 14, 1865, just five days after the surrender of Lee, Lincoln was fatally wounded in Ford's Theatre, Washington, by John Wilkes Booth, an actor. The President died next day; he was succeeded by Vice-President Andrew Johnson.

ANDREW JOHNSON. Republican. Seventeenth President. 1865–1869.

Andrew Johnson was born at Raleigh, North Carolina, on December 29, 1808. His father was Jacob Johnson; his mother, Mary McDonough. At the age of ten he was apprenticed to a tailor. He learned to read, but did not learn how to write until he had reached manhood. Johnson worked at the tailor's trade for a time in Raleigh and later in Greenville, Tennessee. In 1827 he married Eliza McArdle. Encouraged and aided by his wife, Johnson learned how to write.

In 1828 he was elected alderman in Greenville. In the years that followed he became a well-known political figure. He entered the United States House of Representatives in 1843, and served until 1853, when he became governor of Tennessee. Two years later he was elected to the United States Senate. Johnson, a slave-owner himself, upheld slavery. But he did not believe that the Southern states had the right to secede; he alone, of all the senators from the seceding states, remained faithful to the Union.

In 1862 Johnson became military governor of the part of Tennessee that was under the control of the Union forces. In 1864 the Republicans nominated him for the vice-presidency on the ticket headed by Lincoln. He was elected vice-president in November, 1864. After Lincoln's death (April 15, 1865) Johnson took over the presidency and the difficult task of reconstruction.

In December, 1865, the Thirteenth Amendment, freeing all the slaves, became a part of the Constitution. Not long afterward a number of legislatures in the South passed certain laws which appeared to defy the Thirteenth Amendment. A Congressional Committee on Reconstruction now took charge of affairs in the South; the region was

treated like conquered territory. President Johnson was opposed to this policy; but Congress paid no attention to his wishes.

In 1867 the United States purchased the Alaskan territory from Russia for $7,200,000, thus adding a vast area to the country. In the same year Nebraska entered the Union. In 1868 the quarrel between President Johnson and Congress came to a head when certain members of Congress tried to have him removed from office; but they did not succeed. In this year the Fourteenth Amendment, protecting the legal rights of the Negro, became a part of the Constitution.

Eight of the seceding states—Georgia, Florida, Alabama, Louisiana, South Carolina, Arkansas, Tennessee and North Carolina—were taken back into the Union in Johnson's administration. However, a number of federal troops remained in the South in order to uphold the authority of the federal government.

In 1868 Johnson sought the Democratic nomination for the presidency, but was unsuccessful. He was elected senator from Tennessee for the 1875-1881 term. He died at Carter's Station, Tennessee, on July 31, 1875, before taking his seat.

ULYSSES SIMPSON GRANT. Republican. Eighteenth President. 1869–1877.

Ulysses Simpson Grant was born at Point Pleasant, Ohio, on the 27th of April, 1822; he was the son of Jesse Grant and Hannah Simpson. His given name was originally Hiram Ulysses; but when he entered the Military Academy at West Point, the name was recorded by mistake as Ulysses Simpson. Grant decided to keep this name.

He was graduated from West Point in 1843, and became a second lieutenant in the regular army. He saw service in the Mexican War (1846-48), distinguishing himself particularly in the battle of Molino del Rey. After the war Grant married Julia T. Dent. There followed six years of garrison duty in various frontier areas.

In 1854 Grant resigned from the service with the rank of captain. He tried his hand at farming and real estate in turn, but failed in both enterprises. In 1860 he moved to Galena, Illinois, where he worked in his father's leather store for a modest salary.

At the outbreak of the Civil War, Grant offered his services to the War Department. In June, 1861, he was given a colonel's commission; two months later he was promoted to the rank of brigadier general. He first distinguished himself in February, 1862, when he captured Forts Henry and Donelson, in Tennessee. His capture of Vicksburg in July, 1863, was one of the most brilliant exploits of the war. In March, 1864, Grant took over the command of the armies of the Union, and it was under his leadership that the war was brought to a close.

In 1866 Grant was commissioned General of the Army of the United States. He was now recognized as the foremost citizen of the republic. He won the Republican nomination for president in 1868, and scored an overwhelming victory at the polls over his Democratic opponent, Horatio Seymour.

In the first year of Grant's administration (1869) East and West were connected by railway for the first time. In the following year the Fifteenth Amendment was adopted. It provided that no citizen should be deprived of his vote because of "race, color or previous condition of servitude." Reconstruction went on in the South during Grant's first term. Virginia, Mississippi and Texas were taken back into the Union.

Grant was re-elected by a safe margin in 1872. No sooner had he entered upon his second term of office, in March, 1873, than a terrible financial panic occurred. Many banks stopped payment and many business houses failed. Congress passed a bill to meet the crisis by inflating the currency; but Grant vetoed the measure.

In 1873 the United States almost went to war with Spain over the Virginius, a ship that was seized by the Spanish while she was flying the American flag. The United States State Department, however, found that the Virginius had no right to fly American colors; nothing came of the threat of war.

In 1876 Colorado was admitted to the Union. At about this time the country was stirred by a series of financial scandals. It was found that dishonest men had stolen millions of dollars in government funds. Grant was blamed for these frauds, because he had permitted unworthy men to occupy positions of trust in the government.

In 1877 Grant made a tour of the world, receiving great honors wherever he went. He failed to win the nomination for a third term in 1880. Shortly afterward he moved to New York and became a partner in the firm of Grant and Ward. This firm failed in 1884; and Grant gave up all his property to satisfy his creditors. Though he was suffering from an incurable illness, he set to work to write his memoirs, hoping that the sale would provide for his wife's needs. He died at Mount McGregor, near Saratoga, New York, on July 23, 1885.

RUTHERFORD B. HAYES. Republican. Nineteenth President. 1877–1881.

Rutherford Birchard Hayes was born at Delaware, in Ohio, on October 4, 1822; he was the son of Rutherford Hayes and Sophia Birchard. In 1842 he was graduated from Kenyon College. He attended the law school of Harvard University and was admitted to the Ohio bar in 1845. He became a prominent lawyer in his native state. In 1852 he married Lucy Webb. He was city solicitor of Cincinnati from 1858 to 1861.

When the Civil War broke out in 1861, Hayes received a major's commission. He fought bravely in the war, rising to the rank of brevet major general. (A brevet is a commission giving an officer higher rank than that for which he receives pay.) While still in the Army, he was nominated for the House of Representatives; he was elected for the 1865-67 term. In 1867 he was elected governor of Ohio and served three terms.

Hayes was nominated for the presidency by the Republican National Convention in 1876; his Democratic opponent was Samuel J. Tilden. The election was so close that its result was disputed. A special body, known as the Electoral Commission, was appointed to settle the matter. This commission decided in favor of Hayes.

In 1877, the first year of Hayes's administration, federal troops were withdrawn from the South. The white people had already gained control in most of the Southern states; after the departure of the troops, they gained control in all.

Hayes aroused the hostility of many of the politicians who had put him in office by urging reform in civil service. Reform meant that there would be fewer government jobs for faithful party workers. As a result he was not nominated for a second term.

In 1881 Hayes retired to private life. He took great interest in education and prison reform; for a time he was president of the National Prison Reform Association. He died at Fremont, Ohio, on January 17, 1893.

JAMES ABRAM GARFIELD. Republican. Twentieth President. March-September, 1881.

James Abram Garfield was born at Orange, Ohio, on November 19, 1831; he was the son of Abraham Garfield and of Eliza Ballou. Garfield was graduated from Williams College, in western Massachusetts, in 1856. Returning to Ohio, he taught Latin and Greek at Hiram Institute; he became its president in 1857. In 1858 he married Lucretia Rudolph. He studied law while teaching and was admitted to the Ohio bar in 1859. In that year he was elected to the Ohio State Senate, and he resigned his presidency at Hiram Institute.

Garfield served in the Union army with great distinction in the Civil War, rising to the rank of major general. In 1862, while still in the army, he was elected to the House of Representatives from Ohio. He resigned his commission in December, 1863, and took his seat as a representative. He was reelected to the House eight times; he became an influential member of that body.

In January, 1880, he entered the United States Senate. In June of that year he was nominated for the presidency by the Republican National Convention. He defeated his Democratic opponent, General Winfield S. Hancock, in the November election.

On July 2, 1881, about four months after his inauguration, Garfield was shot by Charles J. Guiteau, a disappointed office-seeker. The President lingered between life and death for months. He died at last on September 19, 1881, at Elberon, New Jersey.

CHESTER ALAN ARTHUR. Republican. Twenty-first President. 1881–1885.

Chester Alan Arthur was born at Fairfield, Vermont, on October 5, 1830. He was the son of William Arthur and Malvina Stone. In 1848 he was graduated from Union College. For a time he was the principal of an academy at North Pownal, Vermont. He studied law and in 1853 began the practice of that profession in New York City. In 1859 he married Ellen Lewis Herndon.

Arthur served as inspector general and then as quartermaster general of the New York State troops in the Civil War. After the war he became one of the most prominent Republican leaders in the state. From 1871 to 1878 he was collector of the port of New York. He was nominated for the vice-presidency in 1880 on the Republican ticket headed by James A. Garfield. He was elected in November of that year.

Arthur became president in September, 1881, after Garfield had died of a wound inflicted by a disgruntled office-seeker. The shooting of Garfield turned the attention of Congress to the important matter of selecting people for government positions. In 1883 a law was passed setting up a Civil Service Commission and requiring those trying to get certain kinds of government positions to take examinations first. The president no longer had to select men for these positions.

There was great prosperity in Arthur's administration. The cotton industry and manufactures of all kinds flourished. Great

iron mines were opened up. More immigrants than ever before entered the country.

Arthur failed to win the Republican nomination in 1884. He died in New York on November 18, 1886.

GROVER CLEVELAND. Democrat. Twenty-second President. 1885–1889, 1893–1897.

Stephen Grover Cleveland, known during his political career as Grover Cleveland, was born at Caldwell, in New Jersey, on March 18, 1837; he was the son of Richard F. Cleveland and Anne Neal. He received an academic education and was about to enter college when his father died, and the boy had to go to work to help support his family. While a clerk in Buffalo, New York, he studied law. He was admitted to the bar in the year 1859, and soon entered politics.

Cleveland first won a state-wide reputation when he was elected mayor of Buffalo in 1881 on the Democratic ticket. In 1882 he was elected governor of New York State. His record as mayor and governor was so outstanding that he won the Democratic nomination for president in July, 1884. He defeated the Republican presidential candidate, James G. Blaine, in the November election by a close margin.

Cleveland was the first Democrat to become president since the election of 1856. He was the second bachelor to enter the White House. (The first was Buchanan.) However, he did not remain a bachelor long; in 1886 he married Amelia Folsom, daughter of his former law partner.

Several important laws were passed during Cleveland's first administration. The Presidential Succession Act of 1886 provided for the filling of the presidential chair in case both the president and vice-president died in office. It was decided that the members of the Cabinet, if eligible, should succeed in the order in which their offices were created. The Secretary of State would be first in the line of succession.

In 1887 an act was passed setting up an Interstate Commerce Commission in order to regulate freight rates charged by rail carriers. Chinese immigration was forbidden by an act passed in 1888.

Cleveland was defeated for re-election in 1888 and returned to the practice of law in New York City. He was re-elected in 1892. He was the only president who ever served two terms not in succession.

In the year 1893 there was a financial panic that caused much distress. In the following year the Democrats pushed the Wilson tariff bill through Congress; it reduced duties on many articles. Hard times continued; and the Republicans put the blame on the Wilson tariff.

In 1895 a dispute arose between Great Britain and the United States over the boundary line between Venezuela and British Guiana. For a time war threatened; at last, however, the matter was settled by arbitration. In 1896 Utah entered the Union.

Cleveland retired to private life in 1897, settling in Princeton, New Jersey. He delivered an annual series of lectures on public affairs at Princeton University, and he also wrote a number of articles for magazines. He died at Princeton on June 24, 1908.

BENJAMIN HARRISON. Republican. Twenty-third President. 1889–1893.

Benjamin Harrison was born at North Bend, in Ohio, on August 20, 1833. He was the son of John Scott Harrison and Elizabeth F. Irwin, and the grandson of William Henry Harrison, the ninth president. In 1852 he was graduated from Miami University, at Oxford, Ohio. He studied law at Cincinnati and was admitted to the bar in 1853; in that year he married Caroline Lavinia Scott. In 1854 he began the practice of law at Indianapolis, Indiana. He joined the Union army in the Civil War, rising to the rank of brevet brigadier general. After the war he took up his law work again.

In 1876 Harrison was the unsuccessful Republican candidate for governor of Indiana. He served in the United States Senate from 1881 to 1887, and became one of the foremost debaters in that body. In 1888 he was nominated for the presidency by the Republican National Convention; he defeated his Democratic opponent, President Cleveland, in the November election.

In 1889, the first year of Harrison's administration, the territory of Oklahoma was opened to white settlers. Montana, Washington, North Dakota and South Dakota all entered the Union in 1889; Idaho and Wyoming were admitted in the following year.

A conference of independent nations of the Western Hemisphere was held at Washington, in the District of Columbia, in 1889-90. This conference created the Pan-American Union, which has served to bring about closer relations between the countries of the two Americas.

Harrison ran for re-election in 1892 against his old opponent, Grover Cleveland. This time Cleveland won. Harrison returned to private life and the practice of law. His first wife having died, he married Mary Scott Lord Dimmick in 1896. Harrison took part

in the peace conference held at The Hague in 1899, and became a member of the International Board of Arbitration. He died at Indianapolis on March 13, 1901.

WILLIAM McKINLEY. Republican. Twenty-fourth President. 1897–1901.

William McKinley was born at Niles, in Ohio, on the twenty-ninth of January, 1843; he was the son of William McKinley and Nancy Allison. He attended Allegheny College, at Meadville, Pennsylvania, but he was forced to leave college because of illness. He entered the Union army in the Civil War and served throughout that struggle, rising to the rank of brevet major.

After the war McKinley took up the study of law and was admitted to the bar in 1867. He then began to practice law at Canton, Ohio. He entered public life by becoming prosecuting attorney of Stark County, Ohio, in 1870. In the following year he married Ida Saxton.

McKinley was elected to Congress in 1876 and served in the House of Representatives from 1877 to 1883 and from 1885 to 1891. He was an influential congressman; he became chairman of the powerful Ways and Means Committee. In 1892 he became governor of Ohio, remaining in office until 1896. In that year he was nominated for the presidency by the Republican party, and defeated William Jennings Bryan, his Democratic opponent, in the November election.

In 1897 the President pushed the Dingley tariff act through Congress. It was a protective measure, raising duties considerably on a good many items. The country soon showed signs of increasing prosperity; the Republicans claimed that this was due to the Dingley tariff.

The United States was plunged into war in 1898. The inhabitants of Cuba, a Spanish possession, had revolted in 1895, and Spain had been trying to put down the rebellion by harsh means. Congress had protested in vain to Spain against these measures. The warship Maine was sent to Havana in order to protect the interests of American citizens in Cuba.

While in the harbor of Havana the Maine exploded (February 15, 1898), and many officers and sailors were killed. It was supposed that the Spanish had blown up the ship. Relations between the United States and Spain became steadily worse. On April 20, 1898, President McKinley demanded that Spain should withdraw from Cuba. When Spain refused, war was declared.

Spain was no match for the United States. She suffered a series of crushing defeats on land and sea, and in August she had to sue for peace. She had to give Cuba freedom; she ceded Puerto Rico, the Philippines and Guam to the United States, receiving the sum of $20,000,000 by way of payment. Before the end of the Spanish-American War the United States had annexed the Hawaiian Islands. It was clear to the world that the United States had become a world power.

McKinley defeated Bryan again in the election of 1900. Six months after his second inauguration the President was shot by Leon Czolgosz, an anarchist, at the Pan-American Exposition at Buffalo, New York. He died eight days afterward, on September 14, 1901. Vice-President Roosevelt became president.

THEODORE ROOSEVELT. Republican. Twenty-fifth President. 1901–1909.

Theodore Roosevelt was born in New York City on October 27, 1858; he was the son of Theodore Roosevelt and Martha Bullock. He was graduated from Harvard in 1880. In the following year he was elected as a Republican to the New York Assembly. He married Alice Hathaway Lee in 1883.

In 1884 Roosevelt's wife and mother died within a few hours of each other. Saddened by these losses and displeased with the Republican party, Roosevelt withdrew from public life for a time; he became a rancher in the West. In 1886 he returned to New York and was the unsuccessful Republican candidate for mayor. In that year he married Edith Kermit Carow.

In 1880 President Harrison appointed Roosevelt to the United States Civil Service Commission. He served in that post for six years, resigning to become the president of the police board in New York City. From 1897 to 1898 he was Assistant Secretary of the Navy.

When the Spanish-American War broke out in 1898, Roosevelt received a commission as lieutenant general; he served with the First Volunteer Cavalry, nicknamed the Rough Riders. Later he became colonel of this regiment and led it with great distinction.

When the regiment was disbanded after the war, Roosevelt became the Republican candidate for governor of New York. He was elected, and at once began a series of widespread reforms. In 1900 he was nominated for the vice-presidency, running on the Republican ticket headed by President McKinley. The Republicans won the election.

On September 14, 1901, Roosevelt succeeded President McKinley, who had died

of a wound inflicted by an anarchist. The new president took a firm stand against trusts; he also forced settlement of a serious coal strike that had threatened to paralyze the industry of the country.

Cuba had remained under the rule of United States military authorities since Spain had given up the country. In 1902 a constitution drafted by a Cuban convention went into effect. The authority of the United States was withdrawn, and the new republic entered upon the task of self-government.

Roosevelt played an active part in pushing the construction of a canal across the Isthmus of Panama. The United States bought out for $40,000,000 the French company that had started work on the canal. But Colombia, in whose territory the canal lay, raised difficulties. A revolution took place in the isthmus area in 1903, and a new Republic of Panama was set up. This state came to terms with the United States and work on the canal went ahead rapidly.

President Roosevelt was re-elected in 1904. In 1905 he succeeded in bringing about peace between Russia and Japan, which had been at war since February, 1904. Representatives of the two warring countries signed a peace treaty at Portsmouth, New Hampshire, in September, 1905. Roosevelt received the Nobel Peace Prize for his services. (See Index, under Nobel Prizes.)

Great progress was made in preserving America's wild life and natural resources. In 1905 the Forest Service, charged with the protection of the nation's forests, was organized within the Department of Agriculture. In 1909 Congress established funds to provide sanctuaries (places of refuge) for birds.

San Francisco, California, was seriously damaged in April, 1906, by an earthquake and a fire that followed. In that year there were serious disorders in Cuba, and the United States took over the government for a time. Oklahoma entered the Union in 1907.

After retiring from office in 1909, President Roosevelt spent a year in Africa hunting big game. He passed through Europe on his way home and received great honors. In 1912 he was a candidate for the Republican nomination for the presidency. When President Taft was nominated, Roosevelt left the party. He helped to organize a new Progressive party and was its presidential candidate; but he lost the election.

He now went on a voyage of exploration to South America and made important geographical discoveries. When the United States entered World War I in 1917, Roosevelt offered to lead a force of volunteers; but his offer was not accepted. His four sons enlisted, and one was killed. Roosevelt died at Oyster Bay, New York, on January 6, 1919.

WILLIAM HOWARD TAFT. Republican. Twenty-sixth President. 1909–1913.

William Howard Taft was born in Cincinnati, Ohio, on September 15, 1857; he was the son of Alphonso Taft and Louisa Maria Torrey. He was graduated from Yale University in 1878. He studied law in Cincinnati and was admitted to the bar in 1880. In 1886 he married Helen Herron.

Taft soon won distinction in public life. He was judge of the Ohio Superior Court from 1887 to 1890, solicitor-general of the United States from 1890 to 1892 and United States circuit judge from 1892 to 1900. In 1900 President McKinley chose him to head a commission to establish civil government in the Philippines; Taft became the first civil governor of the islands in 1901. He became Secretary of War under President Roosevelt in 1904.

In 1908, with the backing of Roosevelt, Taft won the Republican nomination for the presidency. He defeated William Jennings Bryan in the November election. In general he took a middle-of-the-road position on public questions. (1) He favored the Payne-Aldrich tariff bill of 1909, which reduced duties somewhat. (2) He favored the conservation movement, which sought to preserve the nation's resources, but he wanted Congress, rather than the president, to carry it forward. (3) He believed in regulating trusts and railroads under existing law. (4) He favored civil-service reform.

New Mexico and Arizona were admitted to the Union in the year 1912. This brought the number of states up to the present figure of forty-eight.

Theodore Roosevelt and other Republican liberals thought that Taft had not been progressive enough during his first term. When he was nominated for a second term in 1912, these liberals left the Republican party and formed a new Progressive party. The split in the ranks of the Republicans caused Taft to lose the election.

Taft became professor of law at Yale University in 1913. In 1921 President Harding appointed him chief justice of the United States Supreme Court. He held that post until the year 1930, when he resigned because of ill health. He died in Washington on March 8, 1930.

WOODROW WILSON. Democrat. Twenty-seventh President. 1913–1921.

Thomas Woodrow Wilson (he was later known simply as Woodrow Wilson) was born at Staunton, Virginia, on December 28, 1856; he was the son of the Reverend Joseph R. Wilson and Janet Woodrow. He was graduated from Princeton University in 1879, studied law at the University of Virginia and took his law degree there in 1881. He practiced law for a time in Atlanta, Georgia, and then entered Johns Hopkins University in order to do graduate work. In 1885 he married Ellen Louise Axson. In the following year he received the degree of Ph.D. from Johns Hopkins.

Wilson had a most distinguished career as an educator. After teaching at Bryn Mawr College and Wesleyan University (at Middletown, Connecticut), he was called to Princeton in 1890 as professor of jurisprudence and political economy. He became president of the university in 1902.

In 1910 he was elected governor of New Jersey, and he became widely known as a progressive leader. After a bitter fight he won the Democratic nomination for the presidency in July, 1912. He triumphed in the November election over his opponents of the Republican and Progressive parties. At the same time the Democrats won big majorities in both houses of Congress.

The new administration at once revised the tariff laws. The Underwood tariff of 1913 reduced most duties greatly and did away with some of them entirely. Another important measure of 1913 was the Federal Reserve Act. Among other things it set up twelve banking districts and put the money reserves of these districts in certain key cities. In 1913 the Sixteenth Amendment to the Constitution was adopted. It gave to Congress the power to lay and collect taxes on incomes. In the same year—1913—the Seventeenth Amendment to the Constitution went into effect. It provided that senators were to be elected by the voters and not, as before, by the state legislatures.

A federal income tax law, passed in 1914, placed an annual tax on private incomes. The Clayton Act, passed in the same year, was an anti-trust measure; it aimed to prevent big corporations from taking advantage of their smaller rivals. In 1914 the Panama Canal was completed at last.

In Wilson's first term of office there was considerable trouble with Mexico, which was passing through a period of revolution and civil war. War between Mexico and the United States was narrowly avoided in 1914, when Argentina, Brazil and Chile, the so-called "A. B. C. powers," stepped in as peacemakers. Two years later Mexicans belonging to the army of Villa, a rebel leader, crossed the border and attacked a town in New Mexico. The United States sent an expedition into Mexico with orders to capture Villa dead or alive. The expedition traveled far but accomplished nothing.

World War I, which broke out in August, 1914, created many serious problems for the Wilson Administration. The President at first adopted a policy of strict neutrality.

In 1916 Wilson was re-elected by a very narrow margin over the Republican candidate, Charles Evans Hughes. It soon became clear that the United States would not be able to remain neutral. On January 30, 1917, Germany announced that she would sink without warning neutral merchantmen bound for England, France and Italy. The German ambassador to the United States was dismissed; on April 6, 1917, Congress declared war.

American warships were soon in European waters and American soldiers were in the trenches before the end of October. By the time the fighting ended, on November 11, 1918, more than two million American fighting men were in Europe and two million more were in training on this side. American soldiers fought bravely and had much to do with the final victory.

President Wilson played an important part in the peace conference which drew up the Treaty of Versailles and the draft of a new League of Nations. Bitter opposition developed in the Senate against the peace treaty because it provided for entrance into the League. While President Wilson was touring the country trying to win popular support for the treaty, he was suddenly taken ill at Wichita, Kansas, in September, 1919. He never fully recovered from this attack. Not long afterward the Senate rejected both the peace treaty and the League of Nations.

Wilson's second term was notable for two important amendments to the Constitution. The Eighteenth Amendment (1919) forbade the manufacture or sale of intoxicating liquors; the Nineteenth Amendment (1920) gave women the right to vote.

After he left the White House in March, 1921, Wilson lived the quiet life of an invalid in Washington. He was nursed devotedly by his second wife, Mrs. Edith Bolling Galt, whom he had married in 1915. He died on February 3, 1924.

WARREN G. HARDING. Republican. Twenty-eighth President. 1921–1923.

Warren Gamaliel Harding was born on a farm in Morrow County, Ohio, on the second of November, 1865; he was the son of Dr. George T. Harding and Phoebe Elizabeth Dickerson. He attended Ohio Central College from 1879 to 1882. Upon leaving college, he learned the printing trade; he then served as reporter and editor on the MARION (Ohio) STAR, which he bought in 1884. He married Florence Kling in 1891.

Harding served in the Ohio State Senate from 1900 to 1904; he was lieutenant-governor in 1906. In 1910 he was the unsuccessful Republican candidate for governor. He was elected to the United States Senate by a big majority in 1914. Harding was one of the leading opponents of the Versailles Peace Treaty when it came up for ratification in the Senate. He won the Republican nomination for president in 1920 and easily defeated James M. Cox, the candidate of the Democratic party.

In July, 1921, a treaty of peace was finally signed with Germany. In November of that year a conference of the leading nations—the United States, Great Britain, Japan, France and Italy—was called in order to take up the problem of reducing the world's navies. The conference, which was held in Washington, came to an end in February, 1922; the five powers mentioned above agreed to limit the size of their navies. They scrapped a number of warships in carrying out this agreement. In 1922 the Fordney-McCumber tariff sharply increased duties and extended more protection to a number of industries.

In 1923 it was charged that private companies had unlawfully leased certain naval oil reserves at Elk Hills and Teapot Dome, in Wyoming; the secretary of the interior, Albert B. Fall, was involved in the scandal. Amid the public excitement caused by this affair President Harding suddenly died at San Francisco (August 2, 1923).

CALVIN COOLIDGE. Republican. Twenty-ninth President. 1923–1929.

Calvin Coolidge was born at Plymouth, Vermont, on July 4, 1872; he was the son of John C. Coolidge and Victoria J. Moor. He was graduated from Amherst College in 1895. He then took up the study of the law; he started practice at Northampton, Massachusetts, in 1897. His public career began two years later when he was elected to the Northampton city council. In 1905 he married Grace A. Goodhue.

After serving in the state senate, Coolidge was elected lieutenant-governor of Massachusetts in 1916. In 1918 he became governor of the state. He first became nationally prominent when he took a firm stand against the striking policemen of Boston (September, 1919). In the following year he was nominated vice-president by the Republicans on the ticket headed by Senator Harding. The Republicans won easily in November.

Coolidge succeeded to the presidency upon the death of President Harding in August, 1923. As a result of an investigation by the government, it was found that Secretary of the Interior Albert B. Fall had had no right to lease to private oil companies the naval oil reserves at Elk Hills and Teapot Dome, Wyoming. Later Fall was imprisoned for the part he played in this affair.

Another Harding Cabinet appointee who had aroused public suspicion was Attorney General Harry M. Daugherty. In 1924 President Coolidge removed him from office because he refused to furnish information to a Senate committee which was investigating charges against him.

Coolidge was re-elected in 1924, defeating John W. Davis, Democrat, and Robert M. LaFollette, Independent. The watchword of the new administration was Economy. The national debt was reduced by more than two billion dollars during this period; taxes were also reduced. There was great industrial prosperity. This prosperity, however, was accompanied by a wave of feverish speculation, which helped to bring about a terrible depression that started in 1929.

Coolidge refused to run for re-election in 1928. After leaving the White House, he settled down in Northampton, where he lived quietly. He died on January 6, 1933.

HERBERT CLARK HOOVER. Republican. Thirtieth President. 1929–1933.

Herbert Clark Hoover was born on the 10th of August, 1874, at West Branch, Iowa; his parents, Jesse Hoover and Hulda Minthorn, were Quakers. He was graduated in 1895 from Leland Stanford Junior University, where he took an engineering course. Four years later he married Lou Henry, who was also a graduate of Leland Stanford.

Hoover had a distinguished career as an engineer. After serving for a time with the United States Geological Survey, he directed mining enterprises in the United States, Mexico, Australia, China, India, Burma, South Africa and other lands.

He was in London when World War I broke out in August, 1914. He organized and

directed with great success the American Relief Committee, which helped 200,000 American tourists, stranded in Europe, to return to the United States. In 1915 he was placed at the head of the Commission for Relief in Belgium.

Hoover returned to the United States when we entered the war in April 1917, and was appointed Federal Food Administrator by President Wilson. In 1919 he was named director-general of the American Relief Administration, which supplied the necessities of life for millions of needy Europeans.

Hoover became Secretary of Commerce under President Harding in 1921 and occupied that post for seven years (1921-28). In 1928 he became the Republican candidate for the presidency. He won the election over his Democratic opponent, Governor Alfred E. Smith of New York, by a wide margin.

In the last months of 1929 a great depression set in. It almost paralyzed both industry and agriculture, and millions of people were thrown out of work. President Hoover tried hard to relieve the situation. He had the tariff raised in an effort to protect home industry. He also brought about the creation of the Reconstruction Finance Corporation, which provided emergency loans. But hard times continued.

In January 1933, the Twentieth Amendment to the Constitution was ratified. It provided that the president, vice-president and members of Congress should begin to serve sooner after they were elected than had been the case previously.

The President ran for re-election in 1932 against Franklin D. Roosevelt, the Democratic candidate. Hoover suffered a crushing defeat, receiving only 59 electoral votes out of a total of 531.

FRANKLIN D. ROOSEVELT. Democrat. Thirty-first President. 1933-1945.

Franklin Delano Roosevelt was born at Hyde Park, New York State, on January 30, 1882; he was the son of James Roosevelt and Sara Delano, and fifth cousin of President Theodore Roosevelt. He was graduated from Harvard University in 1904, and he married Anna Eleanor Roosevelt, a distant cousin, in the following year. He studied law at the Columbia University Law School, was admitted to the bar in 1907 and began to practice law in New York City.

In 1910 Roosevelt was elected to the New York State Senate and remained in that body until 1913. In that year President Wilson appointed him Assistant Secretary of the Navy. After serving in that post for seven years, Roosevelt was nominated vice-president on the Democratic ticket in 1920; his running mate was James M. Cox. The Democrats were badly defeated, and Roosevelt retired to private life for a time.

In 1921 he was suddenly stricken with infantile paralysis. He regained his health after a time, but remained permanently crippled as a result of the disease. Roosevelt continued to keep in touch with politics.

In 1928 he was elected governor of New York. He won a wide reputation as a progressive executive and was re-elected by an overwhelming majority in 1930. Roosevelt was nominated for the presidency by the Democrats in 1932. In the November election he easily defeated President Hoover.

When Roosevelt took up his duties as president, the country was in the midst of a great depression; banks were failing in many areas. On March 6 the President closed all the banks; only those on a sound basis were allowed to reopen. After the bank holiday Roosevelt hastened through Congress a series of bills representing a new program for the country; it came to be known as the New Deal.

A number of important measures were passed in 1933 and new government agencies were set up. The Agricultural Adjustment Act (AAA) helped farmers. The National Industrial Recovery Act (NRA) set up codes of fair competition in industry. The Home Owners Loan Corporation (HOLC) lent money to owners of homes. The Tennessee Valley Authority (TVA) provided flood control and furnished cheap electric power.

The Public Works Administration (PWA) provided a program of public works. The Civilian Conservation Corps (CCC) furnished outdoor work to unemployed young men. The Federal Emergency Relief Administration (FERA) helped the states supply relief. In time its work was taken over by the WPA (Works Progress Administration; later called the Work Projects Administration). The WPA set people to work.

The Twenty-first Amendment was ratified in 1933. It repealed the Eighteenth Amendment, which had prohibited the manufacture and sale of intoxicating liquors.

In 1934 the Securities and Exchange Commission (SEC) was established to protect investors in stocks and bonds. In the following year Congress passed the National Labor Relations Act, which gave labor the right to organize and bargain collectively with employers. The Social Security Act provided benefits for millions of workers.

President Roosevelt was re-elected in 1936, defeating Alfred M. Landon. In 1938 Congress passed the Fair Labor Standards Act, setting up minimum wage rates and maximum working hours for millions.

War broke out in Europe in September, 1939. Soon afterward Congress passed the Pittman Act, strongly backed by the President. It partly raised the 1937 embargo on the shipment of arms to nations at war and enabled the Allies to make purchases of war materials in the United States.

In May 1940, the President began preparing the United States against the ever growing threat presented by the Axis powers. Huge appropriations by Congress paved the way for a big American army and navy. In September 1940, the President signed a bill providing for the first peacetime draft in the history of the country. In the same month he gave Great Britain fifty old destroyers in exchange for the right to build naval bases on British territory in the New World.

The President was elected for a third term in November 1940, defeating Wendell L. Willkie. In March of the following year Congress passed the Lend-Lease Act, which aided nations fighting the Axis to obtain supplies from the United States. At last, in December 1941, the United States went to war with the Axis powers. Roosevelt was an active war president.

In November 1944, he was elected for a fourth term, defeating Governor Thomas E. Dewey of New York. The President died suddenly on April 12, 1945, and was succeeded by Vice-President Truman.

HARRY S. TRUMAN. Democrat. Thirty-second President. 1945– .

Harry S. Truman, born in Lamar, Missouri, on May 8, 1884, was the son of John Anderson Truman and Martha Ellen Young. In 1901 he was graduated from the high school at Independence, Missouri.

After working as an errand boy and then as a clerk for several years, Truman took up farming; he remained on the farm until 1917, when the United States entered World War I. Truman enlisted in the field artillery; he received a commission after studying at the Artillery School at Fort Sill, Oklahoma. He went overseas as a captain and saw much service at the front.

Upon his return to the United States, he married his childhood sweetheart, Bess Wallace (1919). After trying his hand at business, he decided to enter politics. In 1922 he was elected as one of the three judges of Jackson County, Missouri. He was the presiding judge of Jackson County from 1926 to 1934.

In 1934 Truman was elected to the United States Senate on the Democratic ticket. Senator Truman first won nation-wide fame in the course of the American re-armament campaign. He became the chairman of a committee that investigated waste in war production. The Truman Committee saved the country some $200,000,000 by pointing out how waste could be avoided.

In 1944 Truman was nominated vice-president on the Democratic ticket as President Roosevelt's running mate. He was elected in November of that year. On April 12, 1945, he became president, following Roosevelt's sudden death.

Like Roosevelt, Truman gave the United Nations (UN) firm support. The permanent charter of the UN was signed at San Francisco on June 26, 1945. On August 2 of that year, Truman, Premier Stalin of Russia and Prime Minister Attlee of Great Britain issued a joint statement at Potsdam, Germany. This Potsdam Declaration outlined the policy to be adopted in dealing with Germany and other World War II foes.

But Russia seemed to be more anxious to spread communism throughout Europe than to work together with her former allies. By his Truman Plan, the President gave aid to Turkey and Greece to help them strengthen their defenses against communist aggression. The Truman Administration also launched an ambitious program to strengthen the democratic nations of Western Europe by giving them financial and other aid. This project came to be known as the European Recovery Program.

In his foreign policy Truman had the backing of the Republican party and the support of most Americans. He was not so successful in carrying out his plans at home. This was particularly true after the Republicans captured both houses of Congress in the 1946 elections. The new Congress turned down most of the President's proposals. It passed the Hartley-Taft Bill, regulating labor practices, over Truman's veto.

There were several splits in the Democratic party before the 1948 presidential elections, and Truman's chances for re-election did not seem very bright. Yet he received 303 electoral votes to 189 for Thomas E. Dewey, heading the Republican ticket, and 39 for J. Strom Thurmond, candidate of the States' Rights Democrats. The Democrats recaptured both houses of Congress.

THE NEXT STORY OF THE UNITED STATES IS ON PAGE 4145.

RKO Radio Pictures, Inc.
A motion-picture camera, mounted on a crane, ready to take a "swoop" shot of an entire scene.

THE STORY of MOTION PICTURES

WHENEVER we look at a scene in a motion picture we are seeing not one but many pictures of various stages of action thrown on a screen rapidly, one after another, so that the eye registers them as one continuous picture. This effect is due to an imperfection of our eyes, called persistence of vision. In simpler terms, our eyes do not stop seeing a thing the instant it disappears. The image formed on the retina (the screen at the back of the eye) remains, or lingers, for a brief space. When we see a motion picture, we are seeing twenty-four different pictures every second, with tiny fractions of a second between where there is no picture. Each image lingers on the retina long enough to bridge the empty, dark gap, so we seem to be observing one continuous moving picture, with lifelike smooth motion.

Here are the chief machines needed to give us a motion picture: 1) a camera that will take pictures in a split second on a strip of moving film; 2) a machine that will "write" sounds; 3) a projecting machine that will throw enlarged images of the pictures on a screen; 4) a sound-projecting machine, with a loudspeaker back of the screen that will turn the sound "writing" back into sounds again.

All these machines are highly complicated, and improvements are constantly being made. We have pictures in color and fantastically high-speed pictures, and soon perhaps we shall have pictures that do not appear flat, but rounded, that is, with depth. Motion pictures, like photographs, may be made by light that our eyes can not see (infrared or ultraviolet). We are already

familiar with the wonders of television.

We shall be having more and more pictures in school and college, making facts clear—a plant waking up in the spring and going through all the stages of a season's growth; the birth of a star; molecules of a liquid changing to a solid, or to a gas. The camera, the telescope, the electron microscope and the artist's pen and brush will work together, making school hours more fascinating and entertainment hours more satisfying. Improvements in the sound machines are being made.

RKO Radio Pictures, Inc.

Taking a full shot. The camera, at left, is enclosed in a soundproof cover to keep its noise out of the microphone, over the counter. The "picture-frame" arrangement is a special device to highlight the principal character.

The marvel that is today's quick-action camera began in 1839, when two men—Daguerre, a Frenchman, and Talbot, an Englishman—announced that a photograph could be made in a few minutes. Before that, crude cameras had needed hours to get a picture. Experimenters after Daguerre and Talbot soon found a way to take pictures in a few seconds; improved plates were made, and in 1872 a sort of motion picture was made. Senator Leland Stanford of California employed a photographer, Edward Muybridge, to set up a row of twenty-four cameras near a race track. From the shutter of each camera a string was stretched across the track in such a way that a horse walking or galloping on the track would break the string, release the shutter and thus take its own picture. When the twenty-four pictures were shown quickly, one after another, the observer saw a horse in motion. After this experiment, many men became excited over the prospect of motion pictures; and they carried out further pioneering experiments.

In 1872 (the same year as the Muybridge experiment), Thomas A. Edison invented a device which he called a kinetoscope (motion-watcher). This was a cylinder with tiny pictures mounted on it; when the cylinder was twirled, the figures on the pictures seemed to be in motion.

In 1888 George Eastman introduced a strip of prepared paper, wound on a roller, to use instead of glass plates in the camera. In about 1892 Eastman began making celluloid film, a very great improvement upon the prepared paper. Hannibal Goodwin, a clergyman, devised a celluloid film at about the same time. In 1893 Edison patented a

kinetoscope using the new celluloid film. The film was unwound inside a box, but the light behind was not strong, and to see the pictures one looked through an opening in the box. Only one person at a time could see the pictures. These machines were set up chiefly in public places beside slot machines. No one paid very much attention to them.

Finally an Englishman got the idea of throwing the pictures on a screen so that many could see them at the same time. With the help of the new film he succeeded. Cameramen were now able to secure a long strip of pictures following each other in proper order; and these pictures were taken at such short intervals that, when thrown upon a screen and passed swiftly before the eyes, they produced the effect of motion. So the name "moving picture" was born.

Each of these tiny film pictures (called a frame) is five-eighths of an inch high and seven-eighths of an inch wide. It takes dozens of frames to show a hand being raised to scratch a nose.

Suppose a picture thrown on the screen shows a man walking along the street. To get this simple action hundreds, sometimes thousands, of little pictures are taken. The first may show the man with his left foot in the air as he is about to step forward. The next picture shows the man with his left foot perhaps an inch lower, the next with his foot an inch lower still, and so on, until you see a picture of the man with his left foot on the ground. All these pictures have followed each other on the screen so swiftly that you believe the man has just placed his foot on the ground. The illusion is perfect.

Now, if these pictures are thrown on the screen at the rate of only one per second, they appear like those of an ordinary magic lantern; but as the moving-picture projection machine begins to revolve faster and faster, the figures in the pictures begin to jerk their limbs this way and that, just as if someone were pulling them by strings. When the operator gets just the right speed, the figures lose their dancing, jerky motion, and walk and act as people do in real life.

The articles that follow will tell you about the motion-picture industry, and will take you on a tour of a "movie lot." You will watch a picture being made, and you will learn some of the trade slang that is spoken in Make-Believe Land.

THE GREAT MOTION-PICTURE INDUSTRY

THE motion-picture industry, in the United States and in England, is an important source of national wealth, with an investment of billions of dollars. Before the war several other countries were building up reputations in the field. Germany, France and Sweden were making notable pictures. The capital of the motion-picture world is Hollywood, California, with its near-by towns of Culver City, Universal City, Burbank and others.

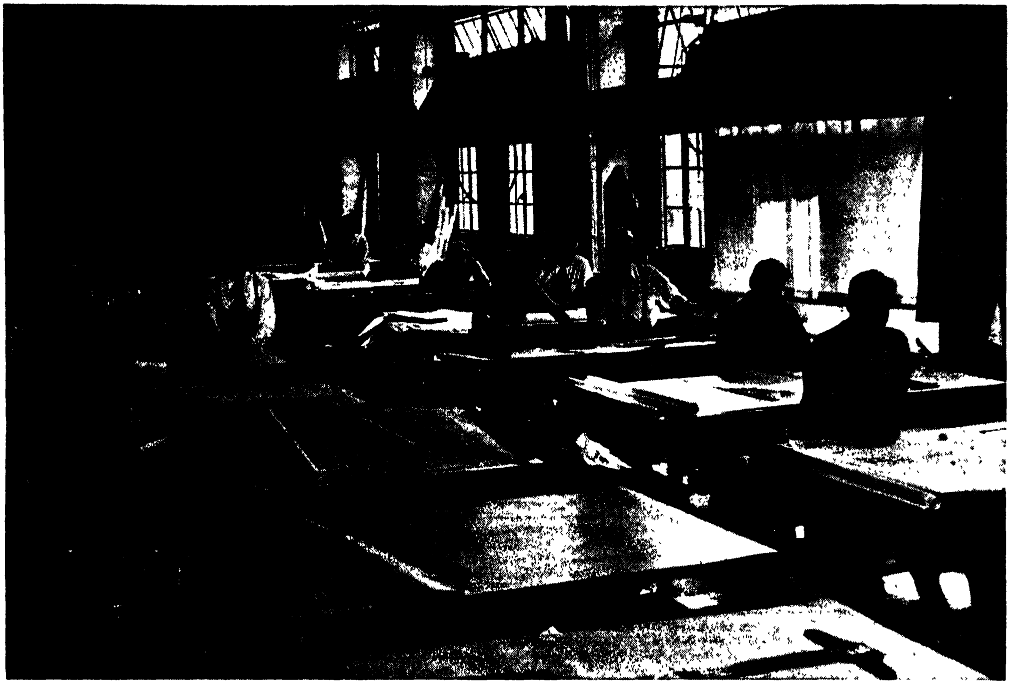
The industry calls upon some of the highest talent in the world—scientists who are in the vanguard in light, sound and color; actors; musicians; writers; mechanical engineers; fashion designers; architects; men and women with dramatic imagination; and business men able to organize and control vast and complicated ventures. Creating a single important picture is a complex project, the work of several thousand people ranging from unskilled laborers through the fields of the various crafts to the most highly trained artists and technicians.

There are five principal elements: the story, the cast (the actors), the settings, photography and sound. A sixth element is rapidly gaining prominence—color. Three persons are at the top of the vast, complicated force combining these elements into a finished motion picture—these three are the producer, the associate producer and the director.

The director may be compared to an orchestra's conductor. He brings together the working elements of the picture so that they harmonize. He not only directs the action of the players, scene by scene; he also sees that photography, sound and the other factors are exactly right.

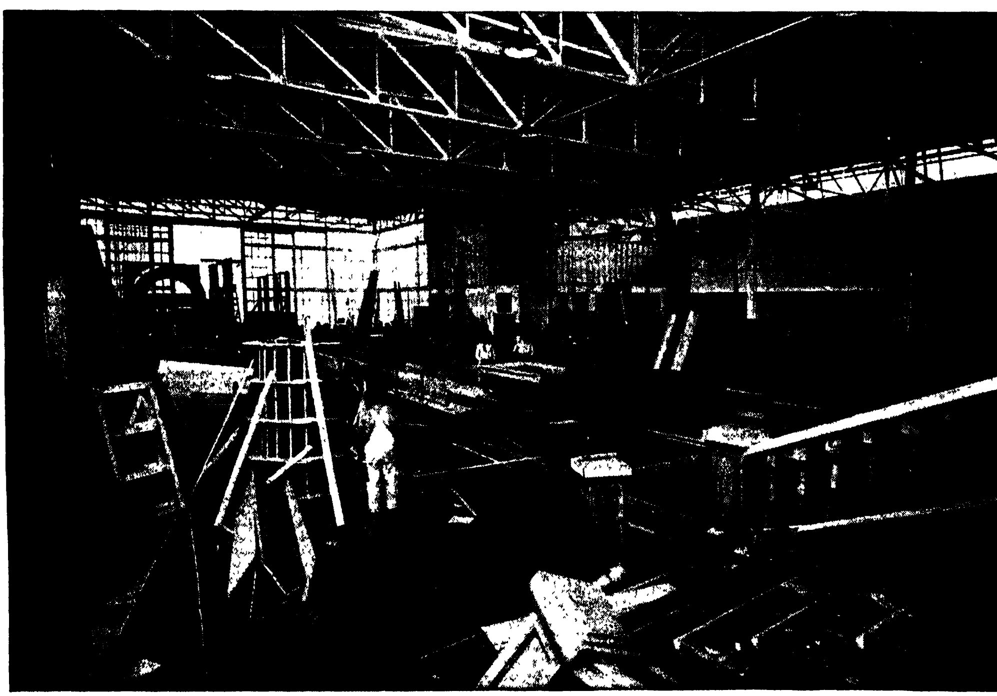
The producer runs the business of the studio. He secures the proper writers and directors, and acquires those literary properties (books, plays, stories and so on) which he believes would make good and successful pictures. Directly under him are his associate producers. An associate producer must be in sympathy with the enthusiasm of his writers, directors, actors, designers and so on. But he must also keep in mind his budget, or cost limit, so that the picture will earn a good profit on the investment.

SKILLED HANDS DESIGN AND CONSTRUCT SETS



Warner Brothers Pictures

Set designers must be good draftsmen and architects as well. The sets must be true to the period of a story.



Metro-Goldwyn-Mayer

Here a set is constructed according to the design and exact measurements of the blueprints made by the draftsmen.

Where do stories come from? The answer is—everywhere and anywhere. Some come from magazines, newspapers, biographies, novels, plays and the like. Some are unpublished stories written especially for the screen; these are called "originals" and hundreds are bought each year. Some studios employ "story scouts" who search the world over for every kind of story, published or unpublished, new or old.

Each studio employs "readers," whose duties are to digest and put in brief form the stories and plays a studio may be considering. If a story is recommended by a reader, it then goes to the Story Department, or Editorial Board, for a second reading. If it meets with approval here, the story is purchased. Many things have to be considered before the story is accepted. Are there stars available to play the chief parts? Is the theme a popular one? Will the expense of producing the picture be too high?

The next step is the making of the story into a screenplay, or script, ready for filming; this was formerly called a scenario. First a screen-writer makes a "treatment"—that is, he writes the action of each scene in order, as it will appear on the screen. Often more than one writer will prepare the treatment. Specialists in writing comedy situations, dramatic scenes or action bits may work together. Screen-writers are among the most versatile and imaginative of all in the writing profession. They have to capture the intent and philosophy written into novels, plays and magazine stories. They often have to create plot structures so that a "best seller" that has been read for its literary flavor will not lose its special quality on the screen.

RKO Radio Pictures, Inc.
The costume designer must choose fabrics carefully. Some colors and textures photograph better than others.

Tom Evans, M.G.M.
A designer's costume sketch being carried out. The camera magnifies details; and workmanship and fitting must bear close inspection.

Before a screenplay is complete for filming, many changes may be made. Decisions affecting these changes are reached in conferences of writers, producers, directors and sometimes players. The screenplay then goes to the stenographic department where about fifty copies are mimeographed. These copies are sent to the heads and subheads of many different departments such as research, art, interior decoration, camera, sound recording, music, make-up, casting, properties and the like. Each department then translates the screenplay into its own terms.

We now have the story purchased and adapted, and it is estimated that this process of careful preparation consumes one-half of the total time of picture-making.

A large part of every studio is occupied by a casting office, peopled by men and women who decide upon and select the actors

Metro-Goldwyn-Mayer

In this "prop" room are every imaginable kind of rifle, medieval armor and oddities, in bewildering profusion.

to play the various rôles in pictures. Casting is a tremendously important part of producing a screenplay.

An expert casting director is gifted with intuitive judgment; he has a trained memory, and, usually, years of association with plays and players. Every casting department has cross-indexed reference files. These contain the names and abilities of hundreds of actors and actresses of all ages. Sometimes a casting director will use these files for small rôles, but for a special part he searches his memory for the person he feels will best play it. In the memory of a good casting director are filed perhaps five thousand actors and actresses—their faces and their abilities.

In every picture there are approximately twelve "principals"—the characters about whom the story revolves. The leading two or three players are called "stars," and the rest are "supporting players."

Below the principals in rank are the background players, or minor players. They have had some experience before the camera and possess some character touches. Some may be listed under such headings as "police," "beard," "collegian," "homely," "society," "freak," and so on. The producer and director work with the casting director in selecting the stars; the casting director usually casts the supporting and minor parts.

The last group of players are "crowd" people, or "extras," or "atmosphere" players, most of whom are hired from the Central Casting Corporation, a bureau formed and owned by the Association of Motion Picture Producers. Those studios which are members of the association pay the expenses for the services of this bureau. It enables the casting directors of many studios to file bulk orders such as "one thousand American Indians," "forty-two airplane mechanics," "twenty police officers." An extra player need make only one telephone call for work instead of having to apply at all the studios; so the benefit is mutual.

When is an actor a star? The word is used to describe a person of supreme attraction in a play or other exhibition. In ancient days there were star gladiators and star minstrels, just as today there are stars in sports or other fields of endeavor. Finding and developing stars for motion pictures have been modernized by the "scout" system. These scouts travel everywhere, watch-

ing amateur performances and looking for talent. Those people discovered are sent to a studio for "tests." A test is a short film episode (generally a scene from an actual picture) which will show the acting and speaking ability of a player. If the test is satisfactory the candidate is sent to "school" and there given daily instruction in acting and voice placement; and he learns how to sit, walk and stand. Following this the player often appears in minor parts, all different, to show every facet of his personality. Then it is decided whether the studio will groom the player for stardom or place him in a lesser category.

The third element in picture-making is termed "settings;" it includes the sets, or built-up backgrounds where the scenes are played, and also the wardrobe, or costumes, to be worn by the players. Usually an art director prepares the settings with the assistance of draftsmen, set designers, architects and builders.

The first step in set-making is the sketch. This is generally done in pencil and submitted to the director and producer for inspection. From this sketch a painting is made, for color is important, even in black-and-white pictures, as some colors photograph more brightly than others. These paintings in turn are submitted to the director, producer and cameraman for approval.

RKO Radio Pictures, Inc.
Testing the intensity of light on an actress's face. It must suit her features and the mood of the scene.

Architects and draftsmen then make blueprints of the sets to be used. Often miniature sets are constructed before the real sets are built. Otherwise the blueprints are taken to the woodworking mill and the settings are erected on the mill floor. When sections are completed, they are taken down and transported to the stages. There the finishing takes place, with painting, varnishing, papering and the like. The set decorator and property men furnish the set according to plan, and as completely as a home, from electricity to running water.

In the meantime "riggers" build platforms around the top of the sets, in order to place the studio lights needed for photography. The set is then ready for use.

MOST BUILDINGS IN OUTDOOR SETS ARE PAINTED "FRONTS"

Nearly every studio has some outdoor sets. Streets, city sections, buildings, railways, etc., are grouped together. They look lifelike, but they are really nothing but "fronts." What appears to be brick and stone may be plaster, painted to deceive any but the closest inspection. When photographed they appear as real as the actual buildings they represent.

The problem of lighting some interiors for photographic purposes has brought about ingenious set-building. For instance, because of the difficulty of lighting the interior of a railway coach, automobile or the like, the set is built in sections. A section can be removed to make room for lights and camera equipment to film another part of the set.

FILMING THE INTERIOR OF A TRAIN AND THE SCENERY MOVING PAST THE WINDOWS

For background scenery flashing past the windows of a moving train, a "process plate" is made. A cameraman films the scenery from a moving car; and the print from this film serves as a background for whatever action takes place in the train. When the scene with the actors is to be photographed, a semi-transparent screen is placed so that it is back of the windows of the railroad car, which does not move. Behind the screen is a projection machine containing the film of the moving scenery. The motion-picture camera and the projection machine are electrically controlled so that they operate together at the same speed. They are started together and the camera not only photographs the interior, but the moving picture of the scenery as well. By this method situations can be filmed that would otherwise be

impossible because of traffic noise and lighting conditions.

Even when background motion is not required, projected backgrounds are sometimes used; and a still simpler method is the use of enlarged photographs or "backings." If a scene is to be played in front of the Capitol at Washington, a photograph of the Capitol is made, then "blown up," or enlarged, and the action photographed in front of the large photograph.

In some cases, a miniature may be built, and photographed. The art of building miniature sets has been so perfected that the average person is unable to detect one in a motion picture. Built by skillful workmen, the cost of these tiny sets runs into astonishing figures. The miniatures are perfect in the finest detail, down to the last moving part.

When it is necessary to photograph scenes away from the studio the location department finds a suitable place. Cast and crews are transported to the chosen location. If hotels or rooms are not available, tents or trailers are used for housing.

In some cases private homes or estates are used, and the owners are paid rent for the privilege. If public streets or parks are used, permission must be granted by the proper municipal departments.

"Props," or properties, is a term inherited from the stage, and designates any movable articles used to provide background or handled by the players during the action of the play. Property departments are huge warehouses containing a wide variety of objects, from a paper of pins to the largest period furniture, and from a hurdy-gurdy to a pair of old duelling pistols.

The head property man must have all the instincts of a detective. Whatever is wanted he must find. Animals fall to his lot, too, and he may be required to produce anything from a thousand moths to a hippopotamus within a few hours' notice.

The property man works with interior decorators and skilled craftsmen of all types, and this united effort is another example of the co-operation required in the making of motion pictures.

Costuming Hollywood's pictures is a business running into millions of dollars a year and calling into play the talents of the world's most famous designers and style authorities. Some of these are under yearly contract to a studio, and others contract for one picture at a time.

Every studio has its wardrobe department, which generally is one of the largest units in the entire film plant. Here are huge, well-lighted workrooms where seamstresses and tailors are busy turning out the fashions of tomorrow, for Hollywood must be months ahead of the current vogue in dress, and often sets styles. Otherwise, by the time a picture is released the cloths worn by the actresses would lack that distinctiveness of style which audiences have come to expect.

Paramount Pictures

Make-up is extremely important in acting before the camera. Even when a young actress plays someone her own age, all her best features must be brought out. A really perfect face is rare, and any lack of proportion must be disguised.

A star's wardrobe for a film is designed and created long before the actual filming of a picture. The players must have fittings and "wardrobe tests" to see how the clothes film. Colors which photograph well are chosen. Clear white is seldom used, as it glares under studio lights. A beautiful dress that looks white on the screen is really pale blue. Men's shirts that look white are blue, light tan or salmon pink.

Historical costumes are absolutely true to their period. The research department examines books, magazines, old paintings and the like to obtain accurate designs. Sketches, drawings and even paintings are made; and when these are approved, the actual making of the costumes is started. Many studios rent costumes from large costuming com-

panies. These concerns have many garments in stock available for immediate use or will make costumes to order. Proper accessories are important. Both studios and costume companies have hundreds of pairs of shoes of all styles, sizes and colors, as well as hand-bags, belts and jewelry. Hats, scarfs, fans and the like are also included in the wardrobes, as the finest detail of dress must be carried out completely.

A motion-picture camera consists of a lens set in a hole in a light-tight box, a shutter for admitting light and a spool on which to wind the exposed film. To make a picture, all that are needed are film and light. Thus the cameraman, an expert on both film and light, works out the fourth element in the making of a motion picture—photography. He must know a great deal about composition and lighting. Just as an artist uses paint, the cameraman uses light. He paints his scene with lights and shadows. Of course, his instrument, the motion-picture camera, is more complicated than a mere lens in a light-tight box, even though it operates on the same principle. It is built with the precision of the finest watch. There is an upper magazine to hold the unexposed film; sprocket wheels carry this film down into the camera; a mechanical arrangement draws the film into place before the lens; a revolving shutter is operated by a motor; and then a lower magazine takes up the film, after it has been exposed. The modern motion-picture camera is enclosed in a sound-proof cover called a "blimp." That is to keep the sound of the camera's gears from getting into the sound track. The camera weighs hundreds of pounds, and it takes twenty-four pictures, or frames, a second.

Three stages in preparing a young actor for the part of an old man. Here he is given a sagging throat, using a spongy rubber material. The make-up in these pictures is by Maurice Seiderman, on actor Orson Welles.

In this step, deep pouches are added under the eyes. A cap is over the actor's hair, and the rubber mask continues over his head.

All pictures, RKO Radio Pictures, Inc.

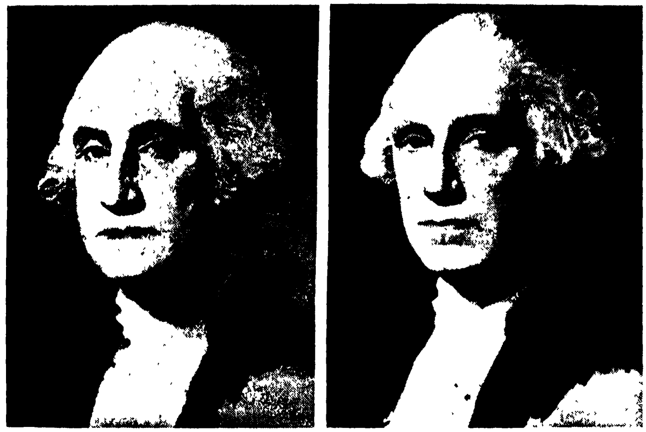
A false mustache is added, and then trimmed. The final step, not shown here, was to add an old man's wig of sparse hair.

It is mounted on a "dolly" or a "perambulator"—a wheeled platform which can be moved forward and back as the players walk about; or it can move to and fro for "pan" (panorama) shots where the camera is swung horizontally to follow players across the screen. Sometimes it is mounted on a crane—a big boom which, raised and lowered mechanically, swings the camera up and down for those breath-taking "swoop" shots, or for scenes of a player ascending or descending a flight of stairs. The crane is really a big dolly, or perambulator. The camera is operated by an electric motor; this gives steadiness of speed in filming the action.

The camera is equipped with a wide assortment of accessories. There are wide, medium and narrow angle lenses for close-ups, medium and long shots; there are color filters, mats, gauzes and discs to give differ-

ing photographic effects for many purposes.

On a single frame of his picture (a space measuring five-eighth by seventh-eighths of an inch), the cameraman catches the scene. This small picture is magnified 30,000 to 40,000 times on average theater screens. You will appreciate the cameraman's precision when we tell you that the threads in a fabric or the individual hairs on a player's head are in sharp focus on the screen. It is easy to see why an error in focusing, though too small to be visible on his little picture, would show up on the screen.



RKO Radio Pictures, Inc.

On the left is a painting of the real George Washington. The other is of an actor made up by Maurice Seiderman to look like Washington. Character make-up like this is an art in itself.

The actual picture which a movie camera takes on the set in Hollywood is a negative. This means that the light-colored things appear dark on the film and the dark-colored articles are light. When a print of this negative is made we have a positive, known as the master positive. On a positive the dark color is dark and the light color is light; in other words, it is a true representation.

From the master positive a set of duplicate negatives is made. Each of these negatives, then, can be used to print many positives; and it is one of these prints which the theater uses when you see a movie.

The original negative and the master positive are kept by the studio. But there may be many prints in circulation all over the country and the world; this is why a movie can be shown in many different places at the same time.

Effective photography is almost entirely a matter of proper lighting. It is used not only to bring out the facial expressions of the players, but also to create dramatic moods. Soft lighting, where no hard shadows are to be seen, is employed when the mood is one of tenderness. Hard, harsh, shadows create an impression of drama, mystery or impending peril. More and more the skillful use of lighting is employed to heighten effects and to create composition and beauty. It has become an art.

Make-up, like lighting, falls under the fourth element of motion-picture production —that is, photography. Make-up must be studied in relation to lighting; thus the skilled expert in make-up must be both artist and scientist. He must be able to add or subtract age. He must be able to create national types, bringing out their dominant features. He may be called upon to create malformed or grotesque characters, or to copy the features of some famous person.

A seemingly perfect make-up may prove unsuitable when it comes before the camera, and only long and varied experience in this intricate work brings a sixth sense of how make-up will actually photograph. These artists are specialists in chemistry, for while it is known that synthetic rubber, wax and other bases are mainstays in the profession, no one but the make-up man himself knows how to formulate and apply these substances. Discoveries are carefully guarded secrets of the profession. Studio make-up departments are recruited from the most imaginative employees of beauty shops and from research workers of the great universities and laboratories.

Sound is a vibration of the air detected by the ear. These vibrations travel in waves which spread from the point of disturbance, as ripples do when a stone is tossed into a still pond. Sound-waves beat against the eardrum just as the water ripples beat against anything in their path.

The sound-recording microphone can best be compared with the human ear. It consists of a very thin and sensitive metal membrane which vibrates at the frequency with which the sound-waves strike it, and responds directly to the strength, or amplitude, of the sound. These vibrations of the metal membrane produce an electric current which alternates, or vibrates, at the fre-

quency and with the strength of the disturbance. This current is amplified, or increased, in strength, and then sent on to the sound-recording machine. The principle is almost the same as that used in a telephone, except that the studio microphones are much more sensitive.

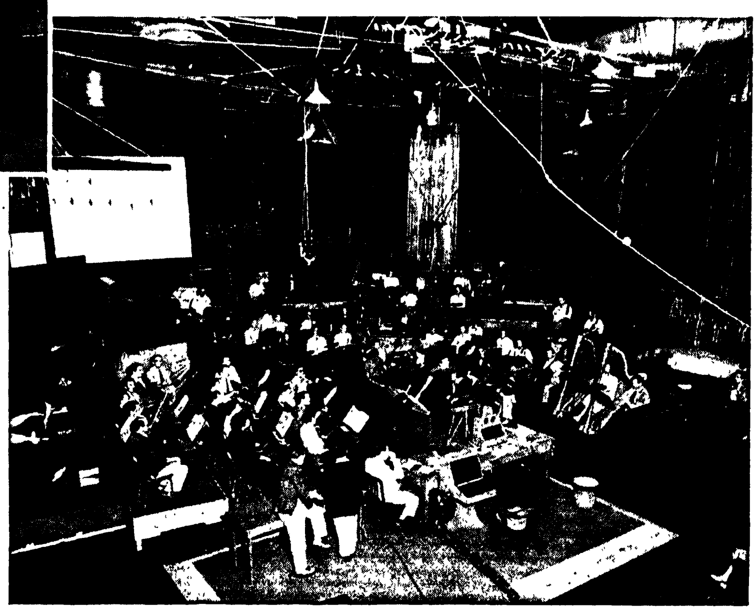
The sound-recording machine consists of a light, a light-valve and a narrow slit through which the light-ray passes on to unexposed motion-picture film, which travels steadily behind the narrow slit. This opening is 1/1000 of an inch wide and 70/1000 of an inch long. The light-valve, which stands between the light and the slit, is the most interesting portion of the sound-recording machine. Sound-recording systems differ in the working of the light-valves and the shape of the sound tracks produced, but all employ the same principle. In each one of them the waves of sound act to release the light-valve so that slits of light are reflected onto the film.

The sound is reproduced in a mechanism called a sound-head, which consists of a light; sprocket wheels, which guide the sound track over a slit; and a photo-electric cell on the other side of the slit. When the sound track passes between the light and the slit, it interrupts the ray of light which falls on the photo-electric cell, causing a fluctuating of the current. This fluctuating current is greatly amplified and then goes to the loudspeakers in the theater.

The recording of music is an interesting and highly technical procedure. Not one but many microphones are employed at the same time to record the music of an orchestra, just as many microphones are employed to bring you your favorite radio program. Through this method the musical director and the sound technician can record the music of each group of instruments at exactly the intensity desired. If a singer is employed, he, too, has his separate microphone. These musical and vocal recordings are made in a specially prepared recording stage, built with perfect acoustics. (That means that the room is built so that there is no distortion of sound, no echo or reverberation and no interference from outside sounds.)

Before the motion picture reaches the theater, the complete sound track is photographically combined with the picture print, just as two photographic negatives may be printed on one piece of paper. On the left-hand side of the positive or final print is a .07 inch track—hardly large enough to notice.

By wearing an earphone, a conductor hears the music he is recording already "mixed." The clock is for split-second timing.



Both pictures, RKO Radio Pictures, Inc.

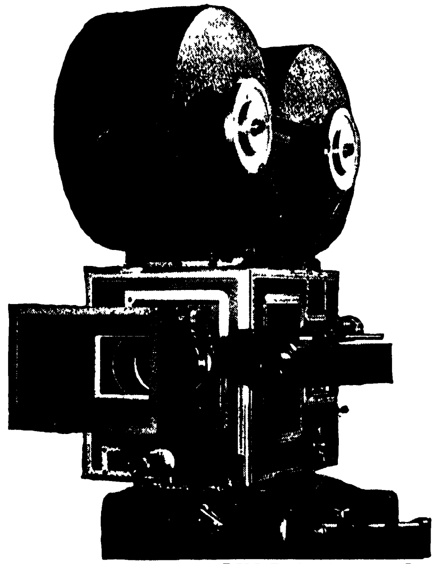
An orchestra ready to play the background music for a picture. As the men play, scenes will be flashed on the screen at the back, so that music and action will fit.

But from this small area comes every sound effect—the roar of traffic and the thunder of battle, the drone of a plane or the ordinary dialog of the players, the clear tones of a singer or the majestic volume of a symphony orchestra.

Color is the fifth and final element in the making of a motion picture. Its growing popularity may be estimated from the fact that in 1932 only 5,526,128 feet of color films were issued, and now several hundred million feet are issued yearly, and the number is still growing larger.

The most successful color obtained so far has been from the three-component or three-strip Technicolor process which may be described briefly as follows:

Light, reflected from an object or scene, enters a single lens and strikes a prism. Part of the light passes through the prism and through a green filter to a primary negative which is sensitive to green. That is, it will "take" an impression only of the greens in the object or scene. The remainder of the light is deflected at right angles and absorbed by two other primary negatives, one sensitive to blue light, the other sensitive to red. These negatives which have recorded the primary color aspects (red, green and blue) of the scene are developed to produce negatives which look like black-and-white negatives; but each is a record of one of the scene's primary colors. If a red barn were photographed in a green field with a blue sky above, the red record negative would have an image of the barn; the green record negative, the image of the field; and the blue record negative, the image of the sky.



RKO Radio Pictures, Inc.
In this color camera, the top space for film is much larger than usual. It must handle three color films, for red, green and blue.

From each of these color-separation negatives a special positive relief image is printed and developed. These positives differ from ordinary positives in that the picture gradations are represented by varying thicknesses of hardened gelatine. These positives, which are called "matrices," are used as printing plates. They absorb suitably colored dyes and are then used in a manner similar to the color plates for a lithograph, the dye image from each of the three matrices being transferred one after the other upon the final completed print ready for projection.

This three-component process calls for a special camera which is manned by a crew of trained operators under the direction of a color photographer.

A single-negative process has been used on several productions, including THUNDERHEAD, SON OF FLICKA and SON OF LASSIE.

By ARTHUR V. JONES.

A VISIT TO THE LAND OF MAKE-BELIEVE

WOULD you like to watch a motion picture being made? First you must have a special pass which will permit you to enter the studio lot, or grounds, where most of the work of picture-making is done. Once inside the gate, you stop and look around in wonder and excitement. You seem to have entered a small, strange city, with narrow streets, and buildings of many kinds elbowing one another. There are towering, barn-like structures with signs over the doors: Stage 9, Stage 20, etc. There are blocks of vine-covered cottages, a great modern business building (the administration offices), perhaps a quaint cluster of houses that seem to have been carried on a magic carpet from a town in medieval Europe.

Suppose we make a tour of the lot. We very soon find that a motion-picture company is a big industry made up of many smaller industries. On our tour we shall find a carpenter shop; a metal shop; a black-

smith snop; a paint shop; a staff shop, where statues and many other things are constructed of plaster; and a florist shop. There is a commissary, or restaurant, where food is served from 8 A.M. to 2 A.M., for the studio is open twenty-four hours a day, seven days a week. We shall also find a garage and mechanics shop that takes care of the trucks and machines used for transportation and also the automobiles, carriages, and even tanks and jeeps you see in the pictures.

The studio has its own tailors and dressmakers, draftsmen, architects, upholsterers, illustrators and leather-workers. There is a zoo containing elephants, camels, monkeys, chimpanzees, bears, deer and many kinds of birds.

In a small building near the blacksmith's shop is the miniature department. Here are constructed miniature cities; tiny bridges to be blown up; and six-foot battleships built to scale and perfect in every detail, capable of operating under their own power, with guns that really fire. There are fleets of airplanes with twelve-inch wingspreads, to fight miniature air battles.

The studio also has its own police force and fire department and a hospital for emergency cases. It has its own library and its own schools for some of the children who are actors. The foreign-looking streets you see may contain permanent or temporary buildings to be used as backgrounds, that is, sets.

The towering, barn-like structures are stages where much of the shooting is done. (Shooting, you know, means the camera work, the picture-taking.) You probably think of the word stage as referring to a raised platform in a theater or assembly hall. On movie lots a whole great building is a stage. It may be, and often is, big enough so that scenes or great, elaborate spectacles may be played there with hundreds of actors, animals, automobiles.

Now let us see what is done to prepare a motion picture for shooting. The studio has decided to make a picture about Napoleon Bonaparte. The story is agreed upon. A producer and a writer are assigned to make the shooting script from the story. A shooting script is a scene-by-scene outline of dialog and action and instructions to the cameraman. The writing of the script may take from three months to a year, depending on how much research the writer and producer have to do and how easily they are able to condense the life of Napoleon into a motion picture that will be two hours long and still be interesting and realistic.

The picture will show many people who have descendants living today. So the legal department now goes over the script very carefully to make sure that there is noth-

Warner Brothers Pictures

A carpenter shop where sets are built from plans—outside views of homes, rooms, offices and so on.

Metro-Goldwyn-Mayer
A blacksmith forges the metal parts needed for sets.

ing in the story that might cause a lawsuit to be brought against the studio for libel.

A director is assigned, also an assistant director, a unit manager (who is the business manager for the company), an art director (who designs the sets) and a cameraman.

Now the really intensive preparation begins. The director and producer start discussions with the casting director, to choose the actors for the main characters in the picture. This might seem to be a simple problem, but it is not.

The stars must be suitable in every way and able to act well together. There may be a very fine actor who is free to undertake the work and known to be good in historical drama. He may have the right qualities in every respect but one—he is a tall man. Napoleon was short and heavy, so this actor will not do for the part.

After the stars have been selected, tests are made for the less important parts. In these tests a scene from the picture is played before the camera by the actors competing for the part. The producer and director and casting director watch the "tests" on the screen and select those players who have given the best performances. Often unknown actors are discovered in this kind of test.

The assistant director and the unit manager, meantime, take the script and "break it down," scene by scene. Each scene, or series of scenes, in one locale (place) is listed on a separate sheet of paper. On this sheet is an estimate of how long these scenes will take to shoot. Also listed are the actors and atmosphere people needed, as well as any special equipment necessary for photographing the scene. When the breakdown is completed, it shows clearly the number of people, equipment and time required for the picture.

During this while, the director, producer and art director have been working together on the set-designing. The sets must be not only true to the time, but must also conform to the way in which the director plans to play his scenes.

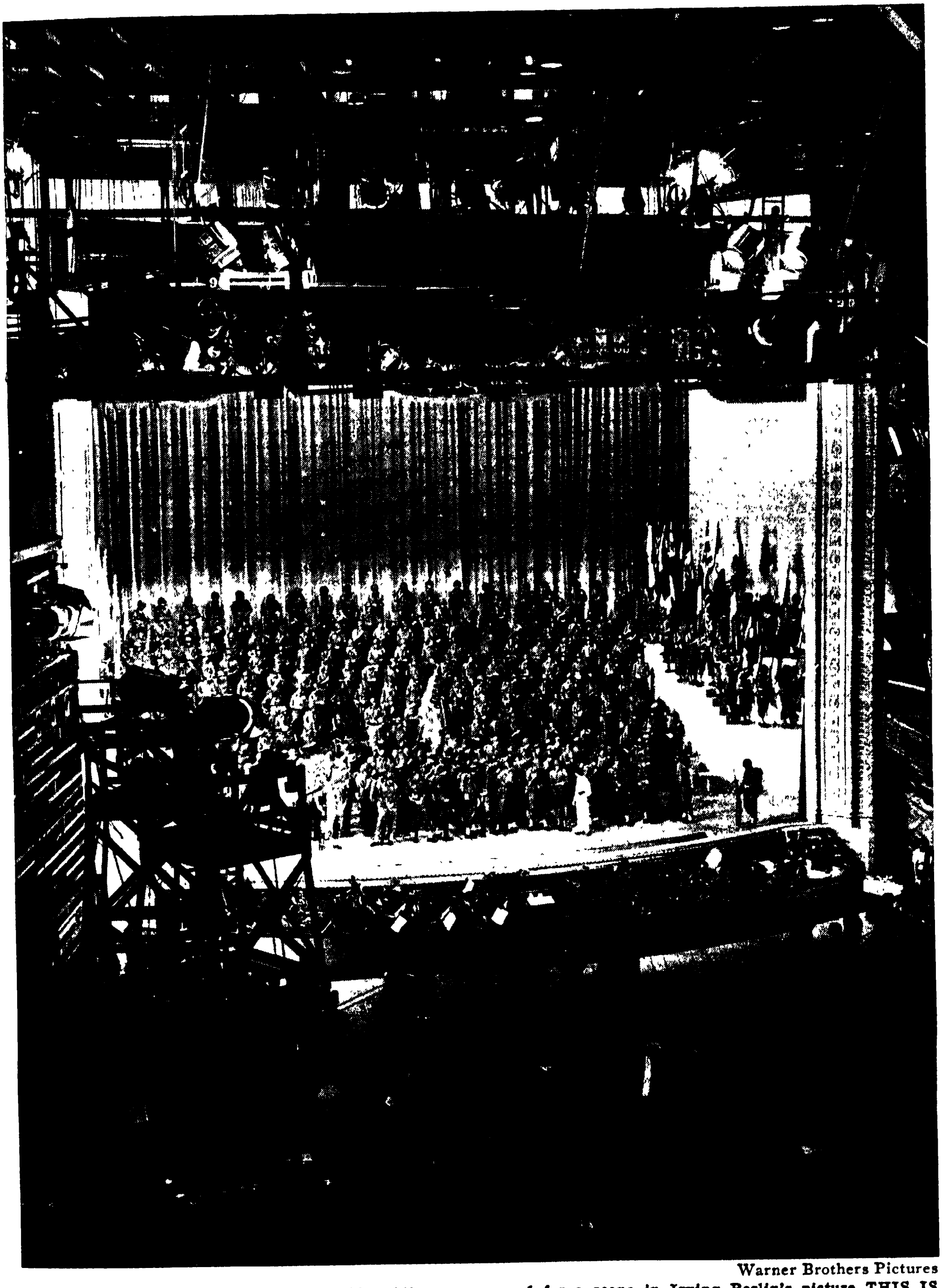
The director and assistant director have also been discussing designs for costumes with the wardrobe departments. Sketches of costumes for the principal characters have been drawn and accepted. The costumes are then made, fitted and in some cases photographed on the actor or actress to make sure that they are becoming.

A property man is now assigned, and he makes his own "breakdown for props." It is his job to see that the props are in their correct places and at hand when needed. The action of a scene may read: "Napoleon picks up his quill pen, and signs away all his power and his glory." In this case both the quill pen and the document are props.

After a long period of intensive preparation, we are ready to start shooting our picture. Our schedule calls for sixty shooting days, but that, of course, is just an estimate. Twenty days of our schedule are to be spent in outdoor locations, and it may be that bad weather will make the outdoor part of the work last much longer.

We shall not be able to shoot our picture in "continuity," that is, starting with the first scene and finishing with the last. Certain members of our cast who appear throughout our story are available only for a limited time; therefore we must concentrate on their scenes. We also have a huge set, a copy of the magnificent palace at Fontainebleau near Paris. This set takes up an entire stage. We have four different groups of scenes in the set, calling for eight days of shooting if we shoot them one after

HOW A GREAT SPECTACLE IS FILMED



Warner Brothers Pictures

On this gigantic sound stage, more than 150 soldiers are massed for a scene in Irving Berlin's picture THIS IS THE ARMY. Lights are slung from the ceiling and mounted on scaffolding, as well as camera and sound recorders.

Both pictures, RKO Radio Pictures, Inc.

A cameraman "riding on a boom." He is on the crane to which the camera is attached. The crane can be raised as much as thirty feet or swung in a complete circle.

another. But if we shot our picture in continuity, the set would tie up that stage for at least forty days. As there are other pictures needing stage space, we must finish that set as soon as possible, and then tear it down. Although our picture will actually begin, when you see it on the screen, with Napoleon as a young man in Paris, watching a mob rioting against the King, our first day's shooting will show Napoleon the emperor attending a great ball at the Palace of Fontainebleau.

On the day before we start, the assistant director makes out his call sheet for the first day. This includes both the cast and the atmosphere people for the ballroom scene. The casting office notifies the members of the cast who are in the ballroom scene that they are to be on the lot the next morning. The Central Casting Corporation is given the call for the atmosphere people, with the specified data on the call sheet as to the number of men and women needed, their age groups and types, such as statesmen, army officers, dowagers, belles, waiters and maids, and so forth. The Central Casting Corporation then goes through its files and starts its switchboard operators calling the extras for the next day's work.

The call is made for 9 A.M. shooting, which means that the company should be ready to make its first shot at 9 A.M. The assistant director must estimate how long it will take to wardrobe (dress in costume) and make up the two hundred extras and have them ready for the first shot at 9 A.M. They must not be called too early as they are paid by overtime periods of two hours each after their first eight hours on the lot. A single overtime period for two hundred extras would cost five or six hundred dollars.

Now for the first day of shooting. The famous actress who is to play Empress Josephine arrives in the make-up department at 6:30 A.M. to be ready on the set at 9. She must sit in a make-up chair while an artist changes her features to look fifteen years older than she will look in her first scene, in the finished picture. The ageing must be done so deftly, however, that you are not too conscious of it.

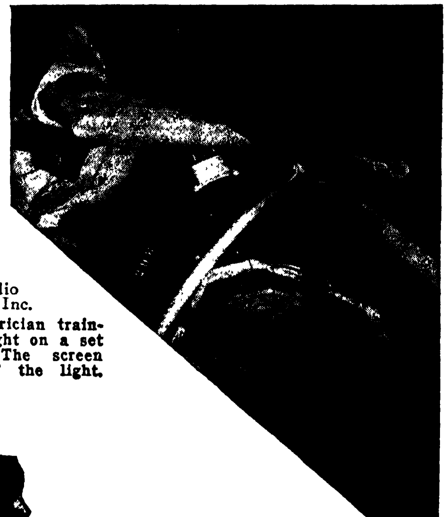
The well-known star who plays Napoleon arrives in the make-up department at 7 o'clock, to be ready at 9.

The unit manager is on the set at 7 o'clock to make sure that the equipment he ordered is all there and that the last-minute changes the director requested yesterday have been made. The art director is also there to see that the set is ready.

At 7:30 the crew arrives to prepare for

The sound engineer at his mixing panel. By twirling the dials, he blends or regulates voice qualities, music and sound effects so that the right combination is recorded.

SCIENCE AND SKILL BEHIND THE SCENES



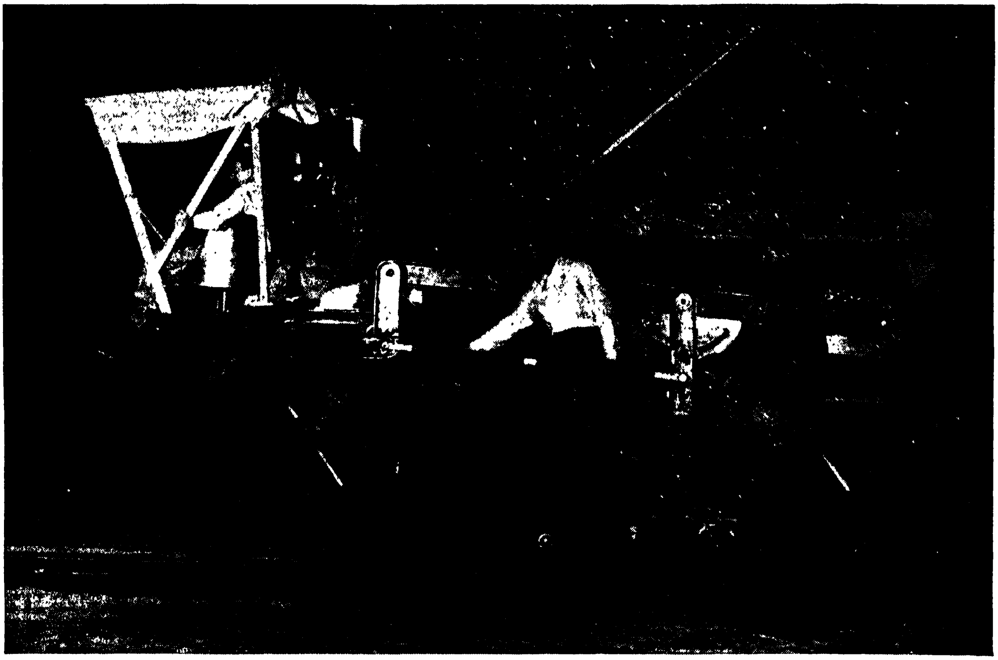
RKO Radio Pictures, Inc.
An electrician training a light on a set below. The screen "softens" the light.

Metro-Goldwyn-Mayer
Examining film, on racks, which has just been developed.

RKO Radio Pictures, Inc.
"Cutting" or editing a picture needs keen eyes, ears and judgment. Action, sound, the various kinds of shots, must all be fitted together so that they will appear on the screen as a smooth, continuous whole.

Warner Brothers Pictures
A number of pictures may call for the same sound effect. It is already recorded on these wax discs, and can be "dubbed in" wherever needed.

RKO Radio Pictures, Inc.
Microphone on a boom arm. The "mike" can be raised or lowered noiselessly, and can pick up sound from all directions.



RKO Radio Pictures, Inc.

Taking a "dolly" shot in an artificial snowstorm. The camera and the whole camera crew move on a wheeled platform, the "dolly," to follow the action. The "snow" in such scenes is usually flake cereal.

the first shot. The director explained to the cameraman the day before where he wishes the camera to be placed for the first shot, and the assistant director is there to see that this order is carried out. The camera crew places the camera in its proper position and checks the lenses and the focus apparatus.

The electrical crew is distributed by the "gaffer," or chief electrician, and his assistant, the "best boy," on the light parallels above the set and on lamps around the set. The lighting problems for motion pictures are very intricate. If you go to a photographer to have your picture taken, he may spend fifteen or twenty minutes arranging lights to make an effective picture of you as you sit quietly in a chair. A motion-picture cameraman must see that his principals are effectively lighted always, even though they may move all over the set in one shot.

By 8:15 the camera man has his general lighting fairly well placed and is ready to concentrate on the lighting for the principal characters; so their "stand-ins" are called. A stand-in is a person who looks somewhat like a principal and who is used in arranging the lighting so that the principal will not have to tire himself, or herself, by being constantly under the lights before the shooting starts. Weariness would show.

By 8:30 the director, the script clerk and the extra players are all on the set. The assistant director places the extra players in their positions and gives them stage business to perform during the scene. The technical adviser, who is an authority on the period we are portraying, stands by to see that there are no historical errors. By 8:50 everything is ready for a rehearsal with the principals.

At 9 A.M. our stars arrive, made up and in costume, and the director starts rehearsing the scene. This may take anywhere from ten minutes for a simple scene to an hour and half for a dramatic scene. As this is merely a long shot of the Emperor and Empress receiving guests, after ten minutes of rehearsal and a few changes of action and lighting, we are ready to shoot.

During the rehearsal the sound crew, consisting of the chief sound man, or "mixer," his assistant, the "stageman," and the recorder, have been carefully observing the action. The stageman operates the microphone which is attached to a long telescoping pole operated from a three-wheeled

standard about eight feet high. It is the stageman's job to keep the microphone as close as possible to the person speaking and yet out of the camera range. He must also be careful not to get the microphone between any light and an actor, or he will throw a shadow on the actor's face. The mixer listens to the scene as it comes through the "mike" and controls the intensity of the sound. He also requires scenes to be shot over if he feels the voice quality is not good or the speeches are not clear enough. The recorder operates the sound camera on which the sound is recorded on film.

The assistant director now yells "Quiet!" The director calls "Turn 'em over"; and the mixer throws a switch which operates the camera and the recording machine and also turns on a red light outside the stage to warn people not to enter. The scene goes well, as it was rehearsed, and the director yells "Cut!" The mixer turns off the switch, and we have made our first shot which covers scene 235, a long shot of Napoleon and his wife receiving guests at a ball.

Scene 236 is a closer shot of the Emperor and Empress. As they stand receiving guests, an aide cames forward and whispers into Napoleon's ear. The Emperor excuses himself and leaves. For this shot the camera must be moved forward, closer to the principals. Of course the lighting must be entirely

Movietone News

Filming wild life at home is thrilling. This deer seems unafraid.

20th Century-Fox Film Corporation

A scene from real life. These natives, paddling their covered canoes down a river in Borneo, appeared in a travel picture. In recent years camera explorers have roamed far and wide to bring us the life of obscure regions.

different for this angle, and it is an hour before we are able to shoot again. After the first "take," the script clerk calls the director's attention to the fact that in the long shot the Empress was carrying a little jeweled bag that hung from her right hand and in the close shot it hung from her left wrist. It would look very strange on the screen to see the bag miraculously change hands without any intervening lapse of time. So the shot must be made over.

As you may notice in the next picture you go to see, there are two methods of showing a lapse of time: the "dissolve" and the "fade-out." The "dissolve" is a quick "fading out" of the scene from the screen and the quick "fading in" of the next scene. This is used to show lapses of time of from a few minutes to several hours. The "fade-out" is a much slower "fading out" of a scene and a slower "fading in" of the next one. This is used to denote the passage of time from several days to years.

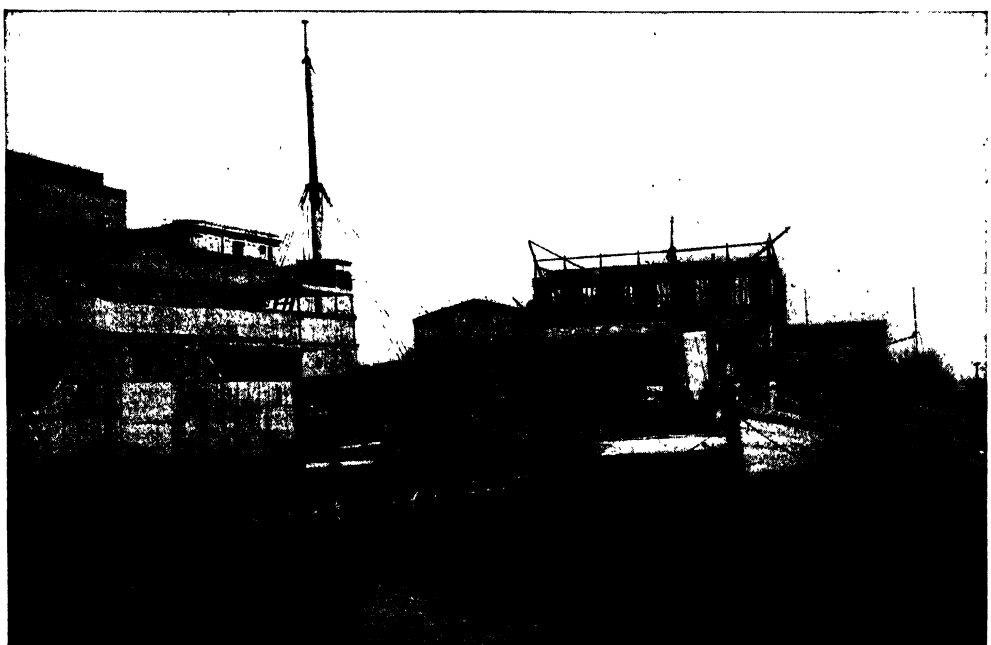
Of course, even when the picture is "in the can," as the cameramen say, it is not finished. Each evening, when the work is done on the set, the film is sent down to the laboratory where it is rushed through developing processes so that the director and his staff can see it in the morning before starting to shoot, in case it should be necessary to retake some scenes. Because it all has to be done at such speed, these morning shows are called "rushes."

Sometimes special effects are necessary after the scene has been shot. For instance, a staff of artists may supply a dust storm or a cloud effect, or rain, or snow when really the scene was shot in calm weather.

The editorial, or cutting, department is one of the most important in the studio. Here the different scenes are spliced together. Sometimes a close shot cuts right into the master shot or long shot, so that suddenly you are brought close to the person speaking and can see his emotion plainly expressed as you sit in the theater. This cutting of the picture is more intricate than any jigsaw puzzle, and sometimes for months after a picture is finished the cutter will work with the director, the producer and often other executives to decide on the most effective arrangement of the scenes. That is why, when you read that your favorite actor is going to play in your favorite story, you frequently wait a whole year.

By WALLACE A. WORSELEY, JR.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 3999.



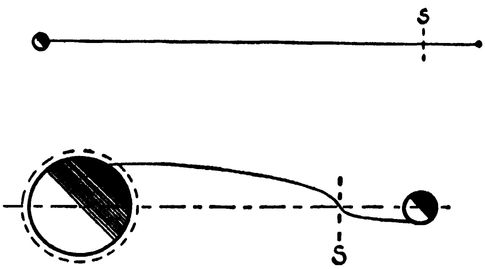
Metro-Goldwyn-Mayer

In this outdoor set, dock and boats are complete, but the building and ship are really painted "fronts."

WONDER

COULD WE EVER TRAVEL TO THE MOON?

ALMOST eighteen centuries ago the first book about a voyage to the moon was written. This was in the time of the Roman Empire; but the writer of the book was a Greek. His name was Lukian of Samosata, and the book was written in Greek. Later generations began to call him by the Latin form of his name—Lucian—and named his book by a Latin title: *Vera Historia.* This means "true story," but Lukian himself warned that "my readers should by no means believe me" and that he was writing of "things which are not and never could have been." He was being honest and could not



The curved line shows the path of a rocket fired vertically. "S" marks the point where the pulls of the earth and the moon become equal. The drawing at the top, of the same path, is in scale.

guess that his fancies might be possible.

Yes, Lukian, or Lucian, certainly wrote of things "which were not and never could have been" in his time, when he told of a captain whose ship was caught in a mighty storm in the Atlantic, blown into the air and deposited on the moon on the eighth day of the adventure. But the important thing is not whether the story was true, or could have been true; the important thing is that people of Lukian's time already knew that the moon is a solid body, like the earth, even though smaller.

What is even more important is that Lukian's story, by the time it is 1,800 years old, may be a true story. It will be 1,800 years old in 1960; and by that time one or several men may have made the trip to the moon, or at least a trip around the moon. Of course, the trip will not be made in a sailing vessel as Lukian described it. It will be made in a scientifically designed space-ship, based on careful computations and thoroughly tested.

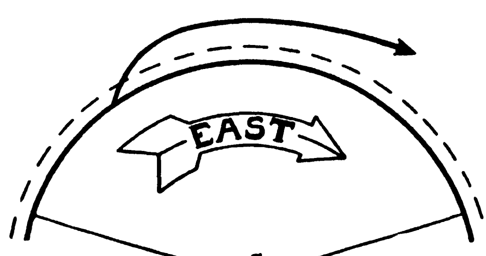
We know everything we need to know for the planning of such a trip. Knowledge amassed during the last two hundred years of human history, but especially during the last twenty years, contains all the answers to all the questions anybody could ask. Nothing remains to be done but the engineering part of the problem. That will cost time and money—probably a good deal of time and a great deal of money. But we know right now that the engineers will, in the end, succeed. The Germans spent about a hundred million dollars developing the long-range rocket, V-2. Even an unmanned rocket to the moon would have to be about four times as large as the V-2. In any event, the expense will probably be high enough to make the project impossible for an individual or even for a large company. But as a government project it will be among the less expensive ones.

Let us stop worrying about money at this point, and begin to face the facts of nature. The distance from the earth to the moon is not fixed, since the moon does not keep a rigid distance on its movement around the earth. Sometimes it is closer, sometimes it is farther away. But while the whole matter of the moon's motion is extremely complicated, astronomers are able to tell the precise distance for any day in advance. They can tell how far the moon will be away on Thanksgiving Day, 1960.

Supposing that the moon happens to be at "average distance" on that day—the answer would be 238,500 miles or, since astronomers mostly use the metric system, the answer would be 384,000 kilometers. This is the distance from the center of the earth to the center of the moon. Since the earth is a ball about 8,000 miles in diameter, and the moon is a ball of about 2,000 miles in diameter, the distance from surface to surface would be some 5,000 miles less than 238,500 miles —that is, about 233,500 miles.

That is not a very long distance. It is only a little less than ten times around the equator; but it is a distance that leads all the way through practically complete emptiness. (There is cosmic dust, extremely tiny particles, floating in space; but it does not need to be taken into account here.) The moon has no atmosphere worth mentioning and that of the earth is only about 600 miles high. Once the atmosphere of the earth has been left behind, the space-ship will be surrounded by absolutely nothing, not counting a possible occasional meteorite, which would be very much unwanted if it did come along.

Because most of the way to the moon there is absolutely nothing, or, to use more precise terms, since most of the way to the moon the space-ship would travel through a vacuum, its propulsion mechanism must be a kind that does work in a vacuum. There is



A better way to reach the moon would be for the rocket to rise vertically only through the earth's atmosphere, and then to run east parallel to the earth.

only one such mechanism known to science —the rocket. It must not be imagined that the rocket motor of the space-ship would be kept running all the 230,000-odd miles between earth and moon. All the space-ship's motor has to do is get the vessel through the atmosphere (where air resistance tries to slow it down) and get its motion up to a certain speed.

THE SPEED NECESSARY TO ESCAPE FROM THE EARTH'S PULL

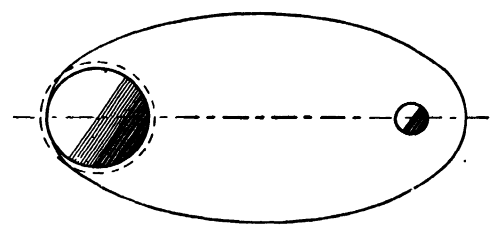
The speed in question is known to scientists as "escape velocity," or "velocity of escape" or "velocity of liberation." In figures it is *7 miles per second* (or 11.2 kilometers per second). Its meaning is this: If you drop a stone from a certain height, say 1 mile, it will hit the ground with a certain speed. If you drop the same stone from 2 miles, it will hit the ground with a higher speed; *but* (and this is important) not with twice as high a speed. If you drop it from 10 miles you get a higher speed than if you dropped it from 1 mile, but not ten times the speed. By means of a computation belonging to the realm of higher mathematics, one can find out with what speed the stone would strike the ground if it were dropped from an infinite altitude (and if there were no air resistance). The answer is 7 miles per second, the figure for "escape velocity," or "velocity of escape."

In other words, a ship that has that velocity (or very slightly higher, as a safety margin) will not fall back to earth, unless its pilot wants it to fall back. Its velocity as it travels from earth is just a little bit higher than the earth's pull on it. The earth's gravity is powerless in the case of so fast a vessel.

If an unmanned space-ship were built, what would it look like? In appearance it would probably look like a long and slender torpedo with large stabilizing tail fins. It would be several times as large and several times as heavy as a V-2, just how much larger and heavier would depend entirely on the fuel used.

When fired it would rise slowly from the ground and go straight up, gradually gaining speed. It is important that such a rocket should not gain speed too slowly, since every second of burning costs many hundreds of pounds of fuel. The rocket, on the other hand, must not gain speed too fast, for higher speed means higher air resistance. The rocket should stay slow until it is at least 10 miles high. Then it can gain speed as fast as the power of its rocket motor permits. The speed will build up at the rate of about 100 feet per second for every second elapsed. Every second that goes by will see the rocket rising 100 feet per second faster than the preceding second. At that rate it needs only some few hundred seconds until the rocket has reached the "velocity of escape."

The most careful estimate says that it will need 8 minutes to do so; probably it can be done in 6 or 6½ minutes. Then no further increase in speed is required. The rocket is now fast enough so that the earth can not hold it any more. True, the earth's gravitational grip is powerful, but the rocket is always just a little bit faster (which is the same as saying that it is just a little bit more powerful). The rocket will lose speed gradually and the earth's gravity will weaken with distance gradually. The problem of the designer is to see to it that the earth's gravity



If the rocket went around the moon, without landing and after taking off as shown in the lower drawing on page 3976, the whole path of its long journey through space would look like this—an ellipse.

(which does not have a limit or a zone where it suddenly disappears, as many people believe) weakens a bit faster than the rocket is losing speed.

At a distance of some 210,000 miles from the earth's surface, or eight-ninths of the way to the moon, the rocket will find an ally: the gravitational attraction of the moon. Like the earth, like all other celestial bodies, the moon exerts a gravitational influence of its own. Since the moon is a comparatively small world, its gravitational influence is also comparatively weak. However, once an object gets near enough, the gravity of the moon becomes noticeable. At 210,000 miles from the earth's surface the gravitational grip of the earth is the same as that of the moon 28,000 miles from the moon's surface.

At that distance, the two pulls are equal. Once the rocket has crossed that line, earth has lost its power completely. Now the moon

is the stronger of the two, drawing the rocket down. It will now simply fall to the moon.

The end would be disastrous. The "escape velocity" of the moon is about 1.5 miles per second, consequently the rocket would hit its surface with that velocity. Actually, the impact velocity would be higher, partly because the rocket may have had some velocity left when crossing the line of equal attraction, and partly because the moon is not standing still in space but has a motion of its own. For this reason—because the moon not only pulls the rocket down but even comes to meet it, in a manner of speaking—the impact velocity would be higher than 1½ miles per second, about 2 miles per second.

If we have a rocket missile that we consider "expendable" for the sake of the experiment, we can permit it to smash on the moon to mark its arrival. But if we have a manned space-ship, these 2 miles per second would pose a problem.

COULD HUMAN PASSENGERS STAND THE RIGORS OF FLIGHT TO THE MOON?

But first we have to find out, the best way we can, whether a man traveling in the nose of such a rocket would survive the trip at all.

Just what does he have to stand?

First, the take-off from earth under considerable acceleration for 6 to 8 minutes. Then, a long period in empty space for the trip itself, lasting roughly four full days. Then the landing on the moon.

It may seem strange, but we have every reason to believe that a man will be able to stand that trip. That he has to travel at 7 miles per second for a time does not mean anything at all. We now know that speed does not matter as far as the human body is concerned; it can not even be felt. What is felt is a *change* in speed, or a change in direction. It is these changes that have to be watched, not the speed itself.

Now the main change is the change from zero (at the earth's surface) to 7 miles per second. If that change is accomplished in between 6 and 8 minutes the space-ship pilot would be under an acceleration of four gravities. One gravity (abbreviated 1 g) is what we feel when we just sit still. The pilot would have to stand four times that much for a maximum of 8 minutes.

Fighter pilots in sudden turns, and dive-bomber pilots in sharp pull-outs, have stood and survived 7, 9 and 8 g. The pilot loses consciousness ("blacks out") at about 6 g. But these turns and pull-outs last only a few seconds, not 8 minutes. For this reason an experiment was made about twenty years ago in Germany. You can imitate acceleration with centrifugal force. A man was whirled around with such a speed that the centrifugal force imitated 4 g. That was kept up for almost nine minutes, with a doctor present. At the end of the time the man was rather dizzy and unhappy (because of the whirling), but he was otherwise perfectly well and had not lost consciousness at all.

PILOT'S REQUIREMENT—HIGH NATURAL RESISTANCE TO "BLACKING OUT"

Now it seems that some people "black out" earlier than others. One could use such a machine to find men with high natural resistance. These men, when found, could use the machine for practice. Of course, a man who can stand the change from zero to 7 miles per second will have no trouble standing the change from 2 miles per second to zero at the other end.

During most of the time there will be nothing to molest the pilot. Of course, traveling through a vacuum, he will need an airtight cabin. He will need enough oxygen to breathe in that airtight cabin. He will need food and water. But all these needs are comparatively small; 220 pounds of air and food and water will last for ten days.

The needs that are not small by any means are the fuel needs. They are incredibly high even for the missile that is just supposed to go to the moon and crash there. They get higher and higher if a manned space-ship is supposed to maneuver. To reduce the falling speed from 2 miles per second to zero needs fuel, and it needs more fuel to carry that fuel. To return to earth after landing, again a change from zero (with regard to the moon) to 2 miles per second so that the ship may pass the line of equal attraction and then fall back to earth, needs more fuel. Which means that still more fuel has to be used to carry fuel for the return.

NINETY-EIGHT TONS OF FUEL FOR A HUNDRED-TON SHIP!

Engineers who try to keep track of such fuel needs arrive at fantastic figures. A hundred-ton ship, of which ninety-eight tons are fuel, is quite normal in these calculations. But the same engineers who calculate such figures also know that they can not build anything like that. They are fairly sure by now that they could build the unmanned missile, but they can not tackle the manned space-ship yet.

There are several ways out of this diffi-

culty, or rather of this storehouse full of difficulties. One is to hope that atomic energy can be used to propel a rocket. So far nobody seems to know just how it could be done, but if somebody can find a way everything will be quite simple. With atomic energy a hundred-ton ship would need only fifty or sixty tons of fuel, which would be a long step toward simplifying the problem. If somebody could promise an atomic rocket motor that would carry a manned space-ship to the moon with an expenditure of only half a pound of fuel for every pound of ship's weight, the first plans could be started next week!

In the meantime, something else could be tried.

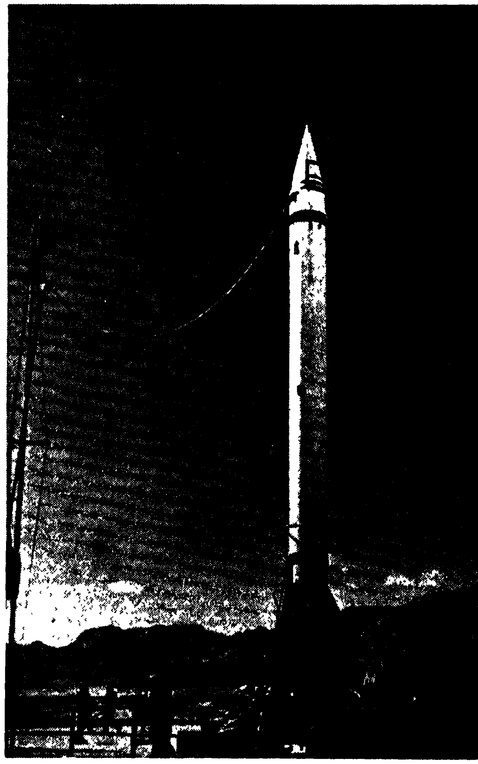
THE GREATER THE SPEED, THE STRONGER THE FIGHT AGAINST GRAVITY

For simplicity's sake we have assumed that our rocket takes off vertically and keeps going vertically, meaning along a line that, if prolonged backward, would pass through the center of the earth. But that is not the most efficient method. Here the ship's rocket motors have to strain against the earth's gravity. Now a rocket motor works the more efficiently, the faster the ship moves. Hence it would save fuel if the ship could attain a high velocity before fighting the earth's gravity. It would then fight the gravity much more efficiently.

Such a problem sounds almost impossible, but there exists a solution for it. It simply means taking off along a curved line. At first the ship would rise vertically, because at first it has to battle both gravity and air resistance. By taking off vertically, as least air resistance is left behind fastest. But as soon as the atmosphere has been passed and left behind, there is no reason for vertical climbing any more. The ship now curves its path in an easterly direction and runs parallel to the earth's surface. Gravity influences it less now and the ship can build up speed. When it is fast it can resume fighting the earth's gravity. Being faster it is now a better gravity fighter.

After this maneuver has been accomplished the ship (with more fuel left) can still follow the direct path to the moon. Or it could do something else: it could just travel along an elliptical path that would not lead it to the moon, but around the moon.

The moon, while moving around the earth, also turns on its own axis. The moon performs both these motions at the same time and at the same rate. For this reason, the same half of it always points toward the earth. This is the half we see whenever the moon is visible at all. No human being has ever seen the other side of the moon. No human being ever will who stays on earth.



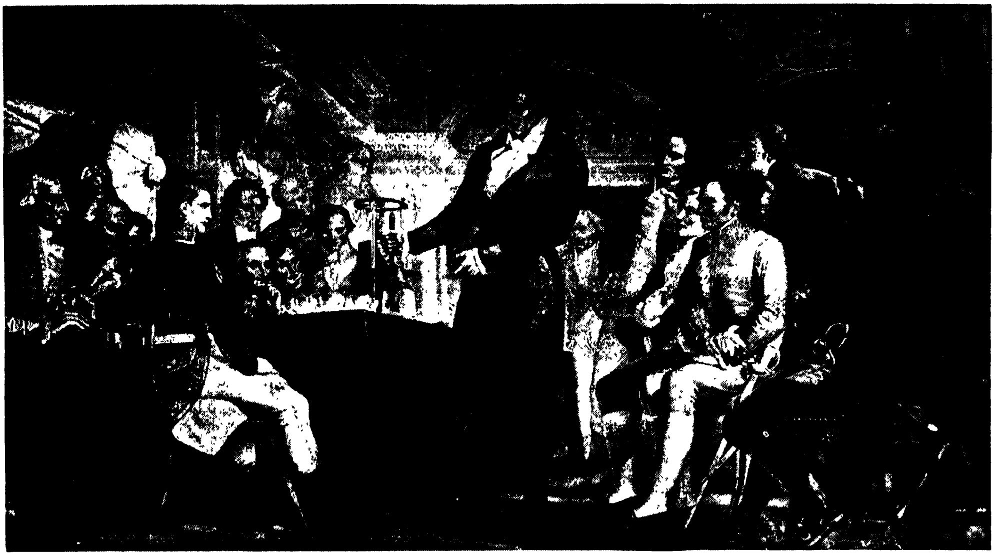
Official photo, U. S. National Military Establishment
Viking rocket in firing position—cable attached to the nose transmits the impulse that starts flight.

The trip around the moon without landing would be of very great scientific interest for that reason. Such a trip, where there is only one landing (that on earth after return), will be valuable practice for the pilot. The landing on earth will require very little fuel, since most of the speed will be killed by careful and wise use of the air resistance the returning ship will find; and so a ship that is to go around the moon will be easier to build than a moon-ship.

For this reason probably the first landing on the moon will be preceded by several trips around the moon without landing. Each one of these trips will teach many and valuable lessons, which can then be applied for the design and construction of the first ship that is to land.

By WILLY LEY.

THE NEXT WONDER QUESTIONS ARE ON PAGE 4065.



Photo, of original picture, by Alinari
Volta demonstrates his great invention—the first workable electric battery—to Napoleon, and French scientists.

THE MEN WHO DISCOVERED ELECTRICITY

ELECTRICITY has always been a part of nature. Picture a violent thunderstorm, with the crash of thunder, and the crackling flash of lightning. In his shelter a cave-man cowers in terror. Perhaps he lies on his back watching the flashing northern lights in the heavens. He is filled with pleasurable amazement. What wondrous power is this which creates such a display? Again he is afraid. Perhaps he is even ready to worship these strange lights, offering sacrifice to them and praying to them not to destroy him.

Our story skips a quarter of a million years. Somewhere some ancient has discovered that amber, rubbed with a piece of fur, has the power to attract to itself small pieces of feathers, wisps of straw and other light substances. We do not know who made this discovery, or when. The earliest description known is attributed to Thales of Miletus (about 600 B.C.), one of the seven wise men of ancient Greece.

Also lost in the dimness of the past is the name of the man who first discovered the lodestone. This remarkable ore has the ability to attract and hold pieces of iron. More useful still, a piece of steel stroked with lodestone and freely suspended will point in a north-south direction. What a wonderful discovery for mariners! Some time during the Middle Ages, the magnetic ship's compass came into use.

What are these mysterious powers of attraction in amber and in lodestone? Within these lifeless substances does a soul or a spirit reside, which is responsible for its peculiar behavior? Such a belief, in one form or another, prevailed for centuries.

In the middle of the sixteenth century Girolamo Cardan (1501-76), famous Italian mathematician, physician and astrologer, stated that amber attracted small objects because it contained a "fatty and glutinous" fluid. Small, dry substances, which had a "desire to absorb" this fluid, were drawn to the amber. The idea that electricity is a fluid persisted for about 300 years, and perhaps a vestige of the idea is still shown when we speak of "turning on the juice."

William Gilbert (1540-1603), physician to Queen Elizabeth of England, showed that amber was not the only substance which could be made to attract light objects. Diamonds, sapphires, glass, sulphur, resin and many other substances also have this peculiar property when rubbed. Since amber

(or *elektron* as the Greeks called it) was the first substance known to exhibit this property, Gilbert named the attractive power *vis electrica*. In 1650, Walter Charleton changed the name to "electricity," and this is the name we now use.

The work on electricity was carried forward by Robert Boyle (1627-91) and Otto von Guericke (1602-86). Boyle showed that electrical attraction can occur through a vacuum. He also proved that the electricity produced in a substance by rubbing remained for some time if the substance was not touched to anything else. Von Guericke invented in 1670 a machine to produce electricity in large quantities. The essential part of the machine was a large ball of sulphur which could be made to rotate rapidly. While it was rotating, Von Guericke held his hand against it, thus charging the ball strongly with electricity. Other men soon produced similar machines with various improvements. Sir Isaac Newton (1642-1727) used a ball of glass in place of sulphur. Later the glass globe was replaced by a cylinder, and finally by a plate of glass.

MEN LEARN THAT IT IS POSSIBLE TO STORE UP ELECTRICITY

Each of these improvements made it easier to produce electricity in quantity. This made possible various startling experiments. For example, the sparks from the machine were used to cause alcohol or wax to burst into flame. The discovery that electricity could be stored was another forward stride. Two men made this discovery independently of each other. In 1745 Eswald Georg von Kleist, dean of the cathedral in Camin, Pomerania, held a small phial in his hand. Within the phial was a nail which was being electrified by contact with the conductor of an electric machine. After the machine had been disconnected, Von Kleist touched the nail with his other hand and, to his surprise, he received a violent shock. In 1746, Pieter van Musschenbroek (1692-1761) of Leyden, Holland, was trying to electrify the water in a bottle. A friend of his named Cunaeus, who was holding the bottle, then began to disconnect the wire leading from the electric machine to the water. He received a violent shock. Later it was shown by Sir William Watson (1715-87), of London, that a dry bottle lined inside and out with tinfoil was even better for the purpose of storing electricity. Such a bottle has become known as a Leyden jar. Taking advantage of the storing power of the Leyden jar, Watson performed many interesting demonstrations. He exploded gunpowder in a musket. He electrified a piece of ice, and with it set fire to some alcohol.

HOW ELECTRICITY CAN BE CONDUCTED

Early in the eighteenth century, Stephen Gray (1696-1736) made the important discovery that some substances, such as metals or hemp, could "convey" electricity from the point where it was produced to some other point. In 1729, he demonstrated this fact by conducting electricity from a rubbed glass rod over several hundred feet of hemp string to an ivory ball. Even though no friction had been applied to the ball, it then attracted small light objects. On the other hand, Gray found that some substances, like silk, could not transmit electricity. Thus he noted the difference between what we, today, call conductors and non-conductors or insulators.

Meanwhile, in France, Charles François de Cisternay du Fay (1698-1739) superintendent of the king's gardens, got wind of the experiments which Gray was performing in England. In many ways he improved on Gray's work. He increased to 1,256 feet the distance over which electricity could be conducted by supporting his hemp string on glass rods. Du Fay discovered that there are two kinds of electricity.

This came about somewhat in the following way. Du Fay rubbed a piece of glass with silk, and a piece of resin with wool. He found that two threads from the silk would repel each other. Similarly, two threads of the wool kept as far away from each other as possible. But a thread of silk and a thread of wool attracted each other. This surprising behavior reminded Du Fay of the action of two magnets, where the north-seeking poles repel each other, and the south-seeking poles repel each other, but the north and south poles attract each other. Hence he reasonably concluded that there are two kinds of electricity—glass-produced, or vitreous; and resin-produced, or resinous. Today we call them positive and negative; it was Benjamin Franklin who introduced these terms.

Franklin was one of the great scientists of his day. His famous kite experiment was but one in a series of experiments for the purpose of studying the nature of electricity.

On November 7, 1749, Franklin made an entry in his notebook. "Electrical fluid agrees with lightning in these particulars: giving light; color of light; crooked direction; swift motion; . . . etc. . . ." Twelve points of

From a Franklin Institute mural by Thornton Oakley
Franklin's kite gathers electricity from the clouds.

similarity were listed. As Franklin expressed it, electricity was "attracted by points," and he wondered whether the same was true of lightning. He wrote, "Since they agree in all the particulars wherein we can already compare them, is it not probable that they agree in this? Let the experiment be made." But how? Perhaps a tower could be built into the clouds—a very expensive project. Perhaps a kite——.

So in 1752 that famous kite experiment was made. Franklin's kite was nothing unusual, except that it was made of silk and that to the top of it he had attached a sharp pointed wire standing one foot or more above the wooden frame. A long string led from the kite, and to the end of the string near the hand was tied a silk ribbon. A key was fastened to the string where it joined this silk ribbon.

The kite was raised during a thunderstorm. When the rain had soaked the kite and string, and when the thunder clouds were overhead, Franklin was able to draw sparks from the key by bringing his knuckle near it. Not only that, he was able to fill a Leyden jar and perform other experiments which are usually performed with static electricity. We must put it down to Franklin's insight and care that he was not killed. He made sure that he stood indoors, where neither he nor the silk ribbon became wet.

Franklin carried out additional experiments which showed that some clouds are charged with positive electricity whereas others are charged negatively, and this was the final clue to the similarity between lightning and electricity. These discoveries led him to invent the lightning-rod which carries the electric discharge into the ground, thus preventing damage to buildings.

DISCOVERING THE RELATION BETWEEN THE FORCES OF GRAVITY AND ELECTRICITY

In the meantime, Joseph Priestley (1733-1804), the famous chemist, had demonstrated a very remarkable fact—there is no electrical attraction inside a charged hollow metal sphere. He discovered this by electrifying a hollow metal cup. Although the cup attracted small objects outside of it, there was no effect on similar small objects dropped into the cup. Since a hollow shell of matter exerts no gravitational force on an object inside it, Priestley concluded that the electrical force must be similar in its behavior to the gravitational force. Therefore, he reasoned, the electrical force between two charges could be expressed mathematically, in the same way that Newton had expressed the gravitational force between two bodies.

A French army officer proved this fact. Charles Augustin Coulomb (1736-1806) entered the army as an officer in the technical troops, and spent the next nine years building fortifications on the island of Martinique, in the West Indies. After his return to France, in 1776, he began scientific work. He perfected a delicate device known as the torsion balance, by means of which he could measure the force between two electrical charges. He found, as Priestley had predicted, that the behavior of electrical forces could be expressed mathematically in the same way as gravitational force. He proved that magnetic forces also behave in this way. It has been said that Henry Cavendish (1731-1810), the eccentric English millionaire scientist, established the law of the reaction between two electrical forces as

early as 1773, before Coulomb had started his electrical studies. But Cavendish never published his findings, and they remained unknown until 1879.

FROM FROG LEGS TO BATTERIES

Up to this time, all the electricity which was known had been produced by rubbing amber, or glass, or resin or some other substance. Now it was discovered that electricity could be produced when a solid or a liquid changed to a gas, or when charcoal was burned. Even animals could produce electricity. The ancient Greeks were aware of the shocks that certain fish in the Mediterranean Sea could deliver. In 1772, Jon Walsh made a thorough investigation of one of these fish, known as the torpedo. Walsh found that by connecting its back and its underside with a conductor, the fish couid be caused to discharge electricity. How the study of electricity in an insignificant animal led to the development of electric batteries is tied up with the stories of two Italians, Luigi Galvani (1737-98) and Alessandro Volta (1745-1827). Both of these men were university professors.

Galvani, who was professor of anatomy at Bologna University, was especially interested in finding out how nerves cause muscles to contract. Since interest in static electricity was running high, it is not surprising to find him using sparks from an electric machine to stimulate contraction of muscles. In 1780 he found that a sparking electric machine caused muscular contraction in frog legs which were in no way connected to the machine. This observation started Galvani on a series of experiments which took eleven years to complete. He attempted to find if lightning would also make frog legs react. Therefore, he took his material outside whenever a thunderstorm occurred, and noted that every time the lightning flashed, the frog legs jumped.

EVEN WITH NO LIGHTNING THE EXPERIMENTS SHOW THE PRESENCE OF ELECTRICITY

However, another peculiar occurrence caught his attention. In some of his experiments, he hung the frog legs on an iron fence-post by means of a brass hook attached to the nerve. Every time the muscle touched the fence-post, the leg jumped, even though the sky was clear and there was no lightning. Galvani thought there might be lightning in the atmosphere, though he did not see it, so he took the frog legs inside. Leaving the brass hook attached to the nerve, he placed the legs on an iron plate. Whenever he let the brass touch the iron plate, the legs jumped. What did this mean? The electricity could not have come from outside. Therefore, reasoned Galvani, it must have come from the nerve itself.


From a Franklin Institute mural by Thornton Oakley
Franklin gets sparks at a key tied to the kitestring.

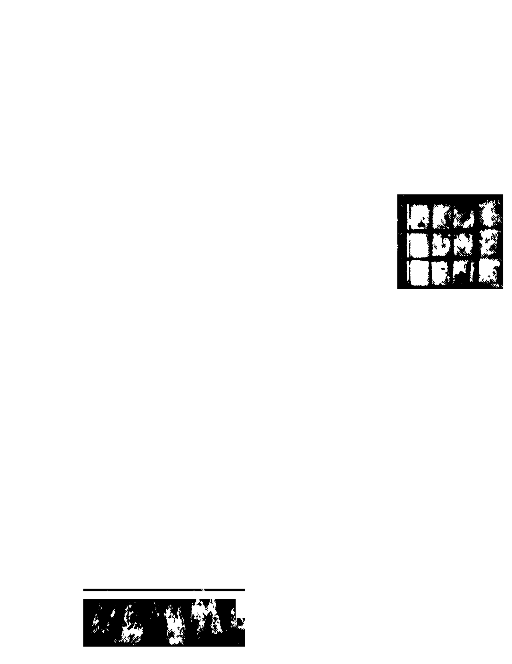
Alessandro Volta, professor at the University of Pavia, was interested in Galvani's work. But Volta stated (1792), "It is clear that the cause of this electricity is the metals themselves." If this is so, why not do away with the frog? Would one still get electricity from the metals by putting them into salt water instead of a frog? Volta tried, and sure enough, he got electricity.

Here was the first practical electric battery —the voltaic cell. Here was a source of electricity never before known. Not static, stationary electricity; but flowing, moving, current electricity. In 1800 Volta announced the voltaic pile, a large number of voltaic

cells connected together, each adding to the effect of the others, and thus providing a ready supply of current electricity.

That same year William Nicholson and Sir Anthony Carlisle dipped the wires leading from such a pile into a container of water and succeeded in decomposing the water into hydrogen and oxygen. This was the first time a substance was broken up by electrolysis. In 1807, Sir Humphry Davy used the same method to decompose other substances and discovered the then unknown elements sodium and potassium. Among other discoveries which resulted from the use of the voltaic pile was the electric arc; this led eventually to modern electric lighting.

Volta's method of producing electrical currents was destined to make tremendous changes in the world's work. The story of how this came about begins with the birth of Michael Faraday in England in 1791. Michael's father, a blacksmith, was unable to provide for his family, and at the age of thirteen Michael began working for a bookbinder. Soon he found the contents of the books interesting, as well. He was especially interested in books dealing with science.



Brown Brothers

Michael Faraday in his laboratory.

A customer at the bookbindery noticed Michael's interest in science and invited him to attend a series of lectures by Sir Humphry Davy. To Faraday's great delight, he soon secured the job of laboratory assistant (actually bottle-washer and clean-up boy) for Sir Humphry. His willingness and his ability impressed Sir Humphry, and Faraday was soon invited to become Davy's special assistant. When Davy went to Europe for a tour lasting eighteen months, Faraday went along. Under Davy's wing, he met men like Ampère, Volta and Gay-Lussac. When he returned to England in 1815, he began his own creative work. At first, this was chiefly in the field of chemistry. But in 1820 he read about Oersted's discovery. . . .

In 1820 Hans Christian Oersted was demonstrating a voltaic pile before a group of students at Copenhagen University, in Denmark. A compass happened to be near the wires leading from the battery. Oersted suddenly noticed, to his amazement, that the compass needle was not pointing toward the north. He knew that a magnet placed near a compass will cause the needle to turn away from the north, but no magnet was near by. He shut off the current in the battery circuit and the compass needle swung back to the north. He turned the current on again and the compass needle turned away from north. The solution struck him. The wire conducting electricity was acting like a magnet. Oersted followed this up, and was soon able to show that a current flowing through a wire causes an electromagnetic field to be set up around the wire.

In Paris, a short while later, André Marie Ampère showed that not only would a current flowing through a wire have an effect on a magnet, but it also had an effect on another current flowing through a near-by wire. If two wires parallel to each other carried currents in the same direction, they attracted each other. But if they carried currents in opposite directions, they repelled each other. Thus, each acted like a magnet.

Ampère was born in 1775. Those were revolutionary days. America revolted in 1776; France, in 1789. In 1793, André saw his father, a wealthy French merchant, sent to the guillotine as an aristocrat. This event upset André's life, and for six years he worked aimlessly. Marriage seemed to give life new meaning for him, and he began to work ambitiously. His interest in mathematics soon brought him into contact with physics, and once he started in this field, he rose to fame. He died in 1836.

Meanwhile, Faraday read about the work

of Oersted, Ampère and others, and set out to make a study of electricity. It occurred to him that if Oersted and Ampère were able to get magnetism by means of electricity, it might be possible to get electricity by means of magnetism.

ALL OUR ELECTRIC MOTORS ARE BASED ON THE RESULTS OF FARADAY'S EXPERIMENTS

He wound two separate coils (insulated from each other) on the same spool. Coil No. 1 was connected to a battery; coil No. 2 to a galvanometer (an instrument which measures current). Faraday expected to find current flowing in the second coil even though it was not attached to the batteries. But the galvanometer needle showed no current. He added more batteries to the circuit of the first coil. Still no current flowed in the second coil. He repeated the experiment time and time again, and then he noticed that although no current flowed in coil No. 2 when current was flowing in coil No. 1, there was a spurt of current in coil No. 2 when the circuit in coil No. 1 was turned on, and again when it was turned off. In other words, an electric current was *induced* in coil No. 2 whenever circuit No. 1 was made or broken. This is the principle of electromagnetic induction. Faraday was right. Magnetism could give rise to electricity, and this discovery has eased the work of man beyond measure.

Faraday made this discovery in 1831. Strangely enough, another man 3,000 miles away was discovering the same thing at the same time—entirely independently. Joseph Henry, a professor at Albany Academy in New York, was on the verge of publishing the results of his experiment which showed that electric currents could be induced by moving a conductor through a magnetic field, when Faraday's article appeared. Henry did not try to claim credit for his discovery, but spoke of "Faraday's admirable discovery." Faraday's discovery (and Henry's too) is the principle upon which the electric generator and the electric motor are based.

William Sturgeon (1783-1850), son of an English shoemaker, wound a spiral coil of wire around a horseshoe-shaped piece of soft iron, to produce the first effective electromagnet. Joseph Henry improved on this by insulating the wire of the coil. His magnets could lift thousands of pounds of steel. Thomas Davenport (1802-51), a blacksmith of Brandon, Vermont, saw one of these electromagnets. Soon after, working with encouragement from Henry, he made the first electric motor. And so it went—magnets, motors, generators, telegraph, telephone, Atlantic cable, all grew directly out of the discovery of electromagnetic induction.

Faraday's work also laid the foundations for wireless and radio. Of course, these things were not immediately realized; it required the work of many men to develop the ideas into practical devices. For example, there was James Clerk-Maxwell. Clerk-Maxwell was born in Edinburgh, Scotland, in 1831, the year Faraday made his discovery. By the time he was thirteen, James was a student at the University of Edinburgh.

Faraday has sometimes been described as "the world's greatest experimenter." However, somehow he accomplished his great work without using much mathematics. Clerk-Maxwell made a thorough study of Faraday's work and translated Faraday's ideas into mathematical equations—the famous Clerk-Maxwell's Equations. These equations, too difficult for anyone except an expert mathematician to understand, showed that light, electricity and magnetism are all basically related, and that light is transmitted as electromagnetic waves in space.

In 1879 Clerk-Maxwell died at the comparatively early age of forty-eight. Shortly afterward, his theory was proved by the work of Heinrich Hertz (1857-94). Hertz was the son of a lawyer in Hamburg. His grandfather had been interested in physics and had set up a small laboratory in which to work. Heinrich inherited this laboratory and here in 1886 he performed a series of experiments which moved Clerk-Maxwell's Equations out of the realm of theory and into the practical world of fact.

AN EXPERIMENT THAT WAS A LONG STEP TOWARD RADIO

Some of these experiments depended on resonance. It was well known that if a tuning fork was set vibrating, the vibrations which traveled through the air could set a second tuning fork of the same pitch into "sympathetic" vibration. This is resonance. Hertz reasoned that if there are such things as electromagnetic waves, perhaps a similar effect could be illustrated. He therefore selected two conductors (these were his tuning forks): he tuned them to exactly the same period of oscillation (this made them of the same pitch); and he sent a spark discharge through one of them (thus setting his first tuning fork in motion). He noted similar spark discharges in the second conductor. He had his sympathetic vibration.

Here you have the fundamental radio set. The first conductor is the transmitter, which sends electromagnetic waves out into space. A second conductor, the receiver, picks up these waves when it is so tuned that it vibrates sympathetically with the first. Simple as this sounds, it was years before practical instruments were developed. Hertz himself died in 1894, only thirty-seven years old. But he had done enough in his short life to be remembered forever. He was followed by a host of other men, like Guglielmo Marconi, who continued the work.

So our ideas as to the nature of electricity have undergone many changes. For several thousands of years, it was assumed that electricity was a spirit residing within matter. This was followed by a period of several hundred years when electricity was considered a material fluid. The work of Faraday, Clerk-Maxwell, Hertz and others indicated that electricity, like magnetism or light, is not a material substance, but rather a "mode of motion," or a form of energy. Electricity and magnetism are closely related, and they create disturbances in space, moving in continuous waves as fast as light.

WHAT IS ELECTRIC CURRENT? SOME NINETEENTH-CENTURY THEORIES

However, it soon became evident that electricity has two aspects which go hand in hand. First of all, there are the electromagnetic disturbances surrounding the substance in which electricity is flowing. Secondly, there is the current itself, flowing through a conductor. Faraday, Clerk-Maxwell, Hertz and others developed our ideas relating to the first, the electromagnetic field, while other men attacked the second phase of the problem—the current itself. One of these men, Johnstone Stoney, asserted in 1874 that electricity flowing in a conductor is composed of many tiny atoms. This idea was carried forward by Hermann von Helmholtz who considered electricity to be a special kind of chemical element.

Evidence for the existence of particles of electricity was produced by the work of Heinrich Geissler (1814-79), J. W. Hittorf (1824-1914) and Sir William Crookes (1832-1919). Geissler pumped some air out of glass tubes and noted that when an electrical discharge was sent through the tube, alternate dark and light bands became visible. Hittorf used a mercury air pump to remove the air from his tubes, and he got higher vacuums. He noticed that the more air he drew from the tube, the greater became the dark area, until finally it filled the whole tube. At this point the glass of the tube began to glow with an eerie fluorescence, and there was evidence of the movement of a mysterious ray within the tube. These rays were given the name of cathode rays, and Hittorf assumed them to be waves in space similar to light-waves. Crookes, on the other hand, showed that these cathode rays must be made of electrified particles.

FURTHER EXPERIMENTS SHOW THAT THERE ARE PARTICLES SMALLER THAN ATOMS

In 1881 J. J. Thomson pointed out that if these cathode rays were really made of rapidly moving charged particles, then according to Clerk-Maxwell's Equations, electromagnetic waves should be produced when these particles struck the glass. These electromagnetic waves were actually discovered by Röntgen in 1895, and the name X-rays applied to them. The discovery of X-rays seemed to provide evidence that cathode rays are really particles of electricity. In 1891 Johnstone Stoney applied the name "electrons" to these particles.

Thus there were now two aspects of electricity to consider, the fact that it seems to travel in waves through space, and the fact that an electric current seems to be a stream of particles. In 1891 Hendrik Antoon Lorentz (1853-1928), a Dutch scientist, tried to bring these two ideas into a single theory. His theory stated that a current is a stream of tiny particles, or electrons, and that it is changes in these particles that cause wave motions in the ether, traveling at the speed of light. (Most scientists believed at this time that space was filled with a mysterious something which they called the ether.)

Of course, the nature of these particles, or electrons, was a mystery. Some people thought they were molecules of the gas left in the vacuum tube. But when they were actually measured by J. J. Thomson, it was found that their mass is only about 1/1850 part of the mass of the hydrogen atom, the smallest atom known. Certainly, then, these particles could not be molecules. They could not even be atoms. Cathode-ray particles (electrons) must be something never before dreamed of. How these and later discoveries helped to bring the greatest revolution in physical science since Newton is told in Men and Women of Science—The Golden Age, on page 1227.

By PHILIP GOLDSTEIN.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 3995.

Figures from the Temple of Zeus at Olympia.

THE EARLY DAYS OF GREECE

THE magic of "Once upon a time" clings to all the art of the ancient world, and when we come to the work of the Ægean peoples, though we are drawing nearer, in actual place, to modern European civilization, the magic of long ago strengthens itself. For the islands of the Ægean, centring in Crete and certain towns on the mainland, like Mycenæ and Tiryns, were the cradle of Greek art; and anything that touches Greece spells not only artistic beauty but also the greatest literature we have inherited from the past.

Just as the art of Egypt, Babylonia and Persia stirs our memories of the Bible, so does the art of Greece, and the work that foreshadowed it, remind us of Homer's tales of heroes and of kings, the voyage of the Argonauts, the unforgettable Trojan War.

We are reminded almost every day of the magic of life and of the fact that mankind is much the same in all ages, when we read in our morning papers how the old walls and columns of buried towns are being brought to light by archæologists. By digging away the covering layers these men and women disclose the very life of the past—not only the buildings and streets, but even the dishes, the toys and the trinkets that belonged to living, breathing persons like you and me.

In the story beginning on page 447 you have read how Henry Schliemann and Sir Arthur Evans gave back to the world the knowledge of the old Ægean culture. You have seen how, by the discovery of the palace of King Minos at Knossos, we can explain quite reasonably the Greek legend of the Labyrinth and the Minotaur. And no one knows what other legends may be traced to their sources, almost any day.

The art of the Ægean civilization, which was at its best nearly two thousand years before Christ lived, showed here and there slight traces of the Egyptian and Assyrian influences with something added—a freedom of line and thought—that the greater nations did not have. The Ægean sculptors escaped the stiffness and coldness and angularity which marked the reliefs and statuary of their neighbors. They seem to have felt the wish to get "back to Nature"—a doctrine which has been preached ever since civilization has made it more and more impossible for people to be quite natural.

The Ægean artists, turning aside from one old convention, began to chisel nude figures. The absence of the nude from Egyptian and Assyrian sculpture has been explained chiefly

on the grounds of religion and custom. When a statue of an Egyptian monarch was set in his tomb to await his coming back to life, it seemed to be a little unfeeling, wanting in reverence, to present this "double" unclothed. Only the meanest slaves went about in a nude, or almost nude, condition. And this convention, which was practically a law, was kept throughout the ages of Egyptian and Babylonian art, even when sculpture was a matter of decoration and had no relation to any living being.

The thoughts and impulses of the Ægean artists ran in another channel. They conceived of unconcealed nature as the most beautiful thing on earth, and wherever possible they introduced natural forms both of plant and of animal life. It seemed to be their ideal to make their work as lifelike as possible, and in the free and voluntary motions of their animal representations, in color and relief, we see something of the greatness of the reindeer-hunter's work. It is quite possible, of course, that some remnant of that work had been found by the earliest Ægean people, and that, though lost to us, it existed sufficiently long to influence their art.

THE SMALL SCALE OF THE WORKS OF THE ÆGEAN SCULPTORS

Generally speaking, the Ægean sculptors worked on a small scale. We have discovered nothing resembling the gigantic statuary or reliefs of Egypt and Assyria. At one period in their art they produced a large number of rather crude little marble statues, but their best work was done on reliefs of precious metal and stone vases. Some of the earliest artists working at Mycenæ hewed a pair of huge lionesses over a gate in the city wall—an almost isolated example of statuary on a large scale.

Probably more than a thousand years before Christ was born the settled civilization of these people in and about the Ægean archipelago was brought to an abrupt end by the breaking-in of some warlike tribes, among them the Dorians, from the hills of Greece lying to the north. The gentle, cultivated Ægeans whose racial strength had been frittered away were helpless before that onslaught which has passed into history as "the descent of the Dorians." They left their islands and towns on the mainland, and scattered east and west. A remnant of them settled in certain islands of the archipelago and in Asia Minor, and there they continued to preserve the elements of their civilization.

THE RICH TREASURE-CITIES THAT LAY BURIED FOR CENTURIES

In the course of time some of their descendants resettled in Greece. They came to be generally known as Ionians, the Ægean archipelago changing its name to the Ionian Isles. The exiled Ægeans had a great deal to do with the rise of Greece to greatness in art. But in the meantime the cities of Mycenæ and Tiryns and Knossos, with all their treasures, were demolished by the invaders and fell to ruin. Other towns rose above or near them, and not till near the end of the nineteenth century, when archæologists set to work upon excavations, was their existence guessed at.

The Dorians and the Ionians formed the two great branches of the Greek peoples; the Dorians centring in Sparta, the Ionians in Athens. It was owing to the Dorians that the term "Hellenes," originating in Hellen, a mythical ancestor of the Dorians, came, at a certain period in their history, to be applied to the Greeks as a whole. The word "Greek" is really an earlier name, and both the terms, Greeks and Hellenes, were originally used only in speaking of a single tribe, afterward becoming general to the nation.

The Dorians and the Ionians gave their names to the chief styles of Greek art. There was a great difference between their thoughts and ideals and character: the Dorians having the hard and stern outlook on life common to mountainous tribes, the Ionians being more ease-loving, pliable and more refined. But from these two influences came in time an art so magnificent as to stand without a peer in history.

It is difficult for us to realize what a wealth of Greek sculpture there was in the golden years of the nation. All the temples and public halls and their precincts were freely adorned with a statuary of whose superb beauty we can only guess from the fragments that remain. When the fall of Greece came there was enough sculpture to make rich the then known world. Much of it was carried away by Roman emperors to decorate their own houses and temples; it went here and there, to Rome, later to Con-

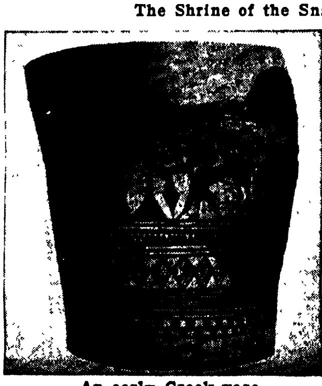
RARE THINGS FROM OLD GREECE

A vase with relief carvings from Crete.

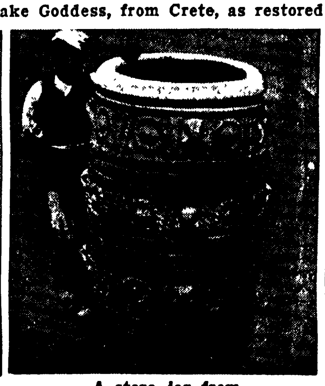
A beautiful vase of the Mycenæan period.

A Cretan vase found at Zakro.

The Shrine of the Snake Goddess, from Crete, as restored by Sir Arthur Evans.



An early Greek vase from Rhodes.



A store jar from Crete.

A Cretan jar with reliefs of the Centaurs.

stantinople; some of it was buried—for pious motives, doubtless. When bronze became valuable, wholesale theft took place; huge quantities of marble sculpture were burned down in kilns for lime. And now a world poorer than it knows by that lamentable loss counts for its chief artistic treasures isolated pieces—nearly all of them buried for centuries—saved from the ruin of Greece.

WHY THE OLD GREEK SCULPTORS WORKED IN MARBLE

Not all this Greek sculpture was pure in the sense of being first hand. There were innumerable original statues, and these were freely copied, often in the workshop of the sculptor; later came work which was merely imitative of the original and the copy.

Wood, stone, metal, marble and terra-cotta were used by the Greek sculptors. Marble naturally is in the lead, as not only was it a fine sensitive medium to work in, but it was freely quarried on the mainland. And many of the islands, notably Naxos and Paros, were largely composed of marble.

Stone was used to a certain extent, but its unpleasant, rough texture was generally hidden by a coat of paint. In the earliest days statues were painted to look as much like life as possible; as the national taste developed, this practice declined, but for a long time color was made use of to enhance the decorative value of statuary, the nude figure being left unpainted, and the draperies and adornments colored in a striking way.

Even the finest marbles for many generations were given a kind of wash of wax melted in oil and rubbed into the surface, in order, it was supposed, to ease the brilliance, painful to the eye, of naked marble when exposed to the sun's glare. Only in later times did the Greek sculptors, becoming enamored of the lovely texture of the marble itself, allow it to remain exposed to the sun and rain.

It was not often that large statues were made in terra-cotta. This medium seems to have recommended itself for the lovely statuettes and figurines which were made in great numbers and deposited with the dead. Burial places like those at Tanagra, in Greece, and Myrina, in Asia Minor, have yielded a great store. There are fine collections of them in the Louvre, the British Museum and the Metropolitan Museum of Art.

The early work of the Greeks was done in bronze and in wood, and the making of bronze statues and reliefs continued even when the national taste had dictated that marble should be used. Centuries of plunder are responsible for the few existing specimens of this metal work. For the same reason, and also because of natural decay, there are no specimens of the statuary in wood, often inlaid with ivory and gilded, that marked the beginnings of Greek sculpture.

How far the feeling of the natural form of wood influenced the early sculptors it is hard to say; there is certainly a resemblance to the form of a tree-trunk in the broken statue of Hera, the body so beautifully folded in a sheath, now in the Louvre, and in the Artemis of the Athens Museum. These two figures, dating from 600 B.C., are our oldest specimens of Greek sculpture.

RARE FIGURES IN THE ART OF EARLY GREECE

Somewhat similar in feeling is the ancient seated figure of King Chares, now in the British Museum, carved about fifty years later. Single figures like these—"free" statues they were called, statues that could be walked around—were rare in the early days of Greek sculpture. The use of statuary in the first case was to adorn a building, even as the first use of pictures was to adorn the space of a wall. And just as for several centuries pictures were painted on the wall itself as part of its fabric, so the early statuary was part of the body of the temple or public building.

Such free statues as existed were set up apart from a building, being generally placed either on tombs or in the precincts of temples or public buildings. These specimens that we have found, notably the Chares, Hera and Artemis fragments, show that in its first stage Greek art had something of the stillness of the Egyptian.

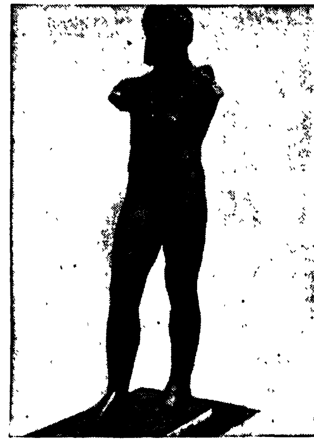
Generally speaking, the art of a race takes about a thousand years to develop; one of the miracles of Greek art is the speed with which it passed, so to speak, from babyhood to youth. Its entire and stupendous history lies within the compass of six centuries, and of these the first three are of supreme interest.

The first sculptors to break away from the tradition of the rigid sheath-inclosed figures were a family living about 550

BEGINNINGS OF A GREAT ART


Statue of Artemis, from Delos.


"The First Smile in Art," the Nike of Delos.


A statue of Poseidon found at Bœotia.


Carved figures on a tomb in the Acropolis of Xanthos, in Lycia.


The Seated Figure of King Chares.


The Gate of Lions at Mycenæ.

The pictures on these pages are reproduced by courtesy of Messrs. Bruckmann, Mansell, and others.

B.C. on the island of Chios. Four generations of Chian sculptors followed each other, and one of them, Archermos, greatly daring, made a statue of a new kind—a winged goddess with arms lifted and limbs in motion. It was a strange figure, with its attempted chiseled draperies, and such movement as it displayed was stiff. To ourselves, trained to the perfection of the Greeks in their prime, it seems a barbaric and unlovely object. But its appearance was an event of great importance. The new goddess—the Winged Nike, or Victory, it was called—was taken as a Greek type, and it marked the beginning of freedom of action and pose characteristic of Greek statuary.

THE MAN WHO IS SAID TO HAVE INVENTED THE SMILE IN ART

In addition to the novelty of movement, Archermos invented another wonder: he made his goddess smile—the first smile, we are told, in art. It had seemed to be the rule for a stone or granite face to be as serious as Time itself, or, if not definitely serious, vacant and expressionless. Herein in two ways the work of Archermos dimly foreshadowed that liberty which was destined to mark the work of his race.

The Chian sculptors came presently to live in Athens, and their new ideas were adopted by their fellow-artists. Meanwhile another development was taking place: the Grecians were beginning to study drapery and to show the beauty of muscular form in their statues; already they were far removed from the rough-hewn shapes of the earlier years.

The art of a country always serves as a kind of commentary on the thoughts and habits of the nation, and in this development we can see the Greek character asserting itself. The Grecians had a growing passion for athletic strength and beauty. Moreover, Athens was a city of philosophers and poets; her intellectual force, her ideals of freedom and liberty of thought, joined to her instinct for bodily perfection, created an art at once physical and spiritual.

But it was an outside more than an inside force that gave the sudden impetus to Greek art, and brought it to maturity about a hundred years after its beginnings.

For some time there had been trouble between Greece and Persia, and in 490 B.C. the Persian armada, most glorious to behold, sailed up to the mainland and landed near Marathon, about twenty miles northeast of Athens. Darius, king of Persia and overlord of some forty-five nations, thought the small country of Greece might be added very easily to his tale of conquests. But their passion for physical perfection had made the Greeks marvelous athletes, and never since the world began was there a battle of such pageantry and glory as that of Marathon, when the Greek soldiers went into the fight at a run. They covered a mile at this pace without apparently feeling any effort, such was their superb physical condition, and they rushed upon the huge Persian army "with one unwavering line of leveled spears," and defeated it utterly.

Ten years later Xerxes, the son of Darius I, took his revenge and attacked Greece again. And before he was driven away he had sacked Athens the beautiful, burned all her temples and those of many other towns as well.

When the Athenians returned to their beloved city they found that the enemy had not only sacked the Acropolis, the central hilly ground where the chief temple and buildings of Athens stood, but had wantonly thrown down most of the sculpture that adorned it. One or two fine groups Xerxes carried away altogether as spoil to Persia. The citizens repaired some of the statues, and the rest, buried as rubbish, were used as material to bank up the Acropolis terraces again. Toward the end of the nineteenth century these broken statues were dug up by excavators, and to the story of the past another chapter was added.

THE NEW GREECE BUILT UP ON THE RUINS OF THE OLD

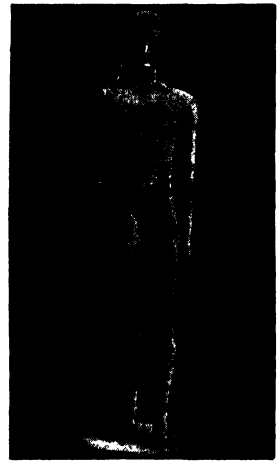
These Persian Wars, which have a haunting, epic sound in our ears, as if all the battles had been in a poet's brain, were the cause of a great new birth of Greek poetry and art. Their chief cities scarred and trampled on, the Grecians hastened to restore them and make them still more beautiful. An accident of spoliation by an Eastern tyrant counted for but a moment in the eternal years; presently a new Athens, a new Greece, rose on the ruins of the old.

The defeat of the Persians was more than a mere victorious ending to a campaign of war. It was the triumph of intellect and liberty over tyranny and

SCULPTURES OF EARLY GREECE


Victory, from the Temple of Zeus.


A fine head of the Ægina period.


An ancient statue of Apollo.


Restored figures of a Bowman and a Man with a Lance, from the temple at Ægina.


A Bowman and a Wounded Warrior, from the temple at Ægina.

barbarism; it was all the forces that make men great—religion, philosophy, love of beauty, centred in one small people, altering the story of the world. We dare not think what would have happened had Persia trampled out Greece. If we take away the Greek art and literature that arose after the Persian Wars we take away the loveliest thing in the world.

Of their ultimate destiny—to be the teachers of mankind two thousand years after they were dead—the Greeks, of course, knew nothing; they were thinking of home and country, ideals and independence. And we can imagine with what joy a sculptor chiseled groups showing Greece triumphant over Persia.

THE FINE BRONZE STATUES THAT WERE MADE AT ÆGINA

In Athens centred the finest work and the highest genius, but there were other schools, such as those of Ægina, Olympia, Sparta and Delphi, where great sculptures were made.

The work of the island of Ægina belongs to the earlier history of Greek art. After the fifth century there is no more mention of the Æginetan sculpture. It formed a school of individual and bold work. At Ægina a fine kind of bronze was made, and much of the statuary was cast in that medium. The most famous of the many sculptors who did their work at Ægina were Callon and Onatas. Statues by Onatas, the more important of the two, were found in many towns in Greece.

At Ægina there was a temple dedicated to Aphaia, the goddess of the island, and to the period at the close of the Persian Wars belongs the interesting sculpture on the pediments. It represents a scene in the Trojan War, but really deals with the recent struggle with Darius. Athene herself, goddess of wisdom and patron saint of Athens, stands between the warriors at the apex of the pediment. The figure of the dying warrior falling at the feet of Athene, and the soldier leaning forward to catch him as he falls, make one of the most memorable groups of early Greek sculpture. Remains of these figures, restored by Thorwaldsen, are in Munich. They once adorned the east and west fronts of the temple, and were rediscovered early in the nineteenth century.

The construction of the Greek temple had much to do with the growth of composition in decorative statuary. A shallow, triangular space crowned the front part of the building. This space is called the *pediment*—perhaps a corruption of the word pyramid. The shape of the pediment made it necessary to have the central figures tallest, with diminishing figures on either hand. You can understand this better if you look at the pediment of the Theseum, on page 5354. Before the time of the Greek sculptors composition in decorative statuary was unknown. Egyptian and Assyrian sculptors merely placed huge figures where it seemed fitting to them, and ran an endless frieze along a wall, the beauty of the frieze being largely the effect of repetitive lines. But the limits of the pediment made such repetition impossible. The sculpture must be bounded by a triangular shape. The central figures usually are standing; those on either side, seated or kneeling; and the ones at the ends, reclining.

In the statues for the temple at Ægina we can see the early artists working out this problem, and again in the temple to Zeus at Olympia. The two chief sculptors concerned with these pediments were Pæonius and Alcamenes. Excavations have recently been made on the site of the temple, and part of the sculpture discovered is preserved in the museum at Olympia and part in the Louvre. The tallest, or central, figure in one of the pediments was Zeus, in the other Apollo, and the sculpture told the tale of some of the myths of Greece. We shall meet them again and again in sculpture, until they are like old friends.

THE ARTISTS WHO SPREAD BEAUTY THROUGHOUT A FAIR LAND

From the fragments that remain of the Olympian sculptures we can see how Greek art was slowly freeing itself from the too-rigid straightness of the earliest years, but at the same time was keeping that dignity and simplicity which characterized the sculpture of the golden years.

As the Greeks restored their ruined towns their sense of beauty unfolded itself like the petals of a flower. In every city of note were artists on fire with zeal.

Statues that singly would have made any town famous appeared in numbers, east and west; those of Attica, whose chief town, we remember, was Athens, always seeming to be more lovely than the rest.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 4215.

Courtesy, The New York Historical Society

Nathan Hale's last words were "I only regret that I have but one life to lose for my country."

TWO SPIES OF THE REVOLUTION

CAPTAIN NATHAN HALE and MAJOR JOHN ANDRÉ

A SPY in time of war is one who visits in disguise the territory held by the enemy for the purpose of gaining information about the enemy's plans. If he wears his uniform he is not a spy, and must be treated as a prisoner of war; but if he wears the uniform of the enemy, or ordinary clothes, he is a spy and may be put to death by hanging. Soldiers think such a death disgraceful, and yet the love of country has always led men to risk their lives to help their commanders gain necessary information. It is considered fair to send out spies, and every army uses them when needed. Here we tell of two brave men.

During the Revolution many spies were sent out by both sides, but two, one American and one English, have been remembered better than all the others. Both were young officers, well educated and lovable. Both risked their lives, were caught and suffered disgraceful deaths while the British army held New York. Monuments have been erected to them both. They were Nathan Hale, American school teacher, and John André, British soldier.

Nathan Hale was born in Coventry, Connecticut, June 6, 1755. Though a delicate child he grew into a strong, handsome boy. When less than sixteen years of age he entered Yale College, and was graduated with honor in 1773, when he was eighteen years old. For two years afterward he was a successful teacher, but when the Revolution began, he left his books, joined the army at Boston and was soon made a captain.

When Washington led the army to New York, young Hale went, of course, but we do not know much about what he did until after the American army was defeated at the battle of Long Island. Washington then retreated to the northern part of Manhattan Island. He did not know whether the British were preparing to attack him or to surround him, and called for a volunteer to enter the British camp.

Captain Hale offered to go, though his friends tried to prevent him. It is said that

his answer was, "I wish to be useful; and every kind of service necessary for the public good becomes honorable by being necessary." He went to Norwalk, in Connecticut, on September 14, 1776, and easily crossed over to Long Island. Disguised as a traveling schoolmaster seeking employment, he visited the British camps in Brooklyn and New York and gained much information which might have been valuable to Washington.

No one seemed to suspect him, and in a few days he returned to the point on the Long Island shore where he had landed. He had given orders that a boat was to meet him there on the morning of September 21 in order to take him back to Norwalk. The night before he spent at a tavern near by, and there he was recognized by a man who informed the British soldiers who he was. Some say that this man was his cousin, who was a Tory, but it can not be proved.

Early the next morning he went out to meet the boat which was to take him back. A boat came, but it was a British boat, and took him to a British ship. There he was searched and notes and plans of the camps were found in his shoes. When he was taken before General Howe, he did not deny who he was or what he had been doing. Though the British general is said to have been much pleased with the behavior of the young officer, the case was plain, and he was sentenced to be hanged the next morning.

The officer in charge of the execution is said to have been brutal and cruel. We are told that he refused to send for a clergyman, or to allow the young man a Bible, and that he tore up the letters Hale had written to his mother, his sisters and the young woman he was to marry. When all was ready, the young hero bravely faced death, saying, "I only regret that I have but one life to lose for my country."

A beautiful statue of the young patriot by Frederick MacMonnies stands in City Hall Park and some think it is near the spot where he gave his life for his country. It is more probable that he was executed nearer the East River and farther north.

This statue of Nathan Hale, by Frederick MacMonnies, stands in City Hall Park, New York.

Now let us turn to the Englishman who also risked his life and lost it. John André, the son of a Swiss merchant of London, was born in 1751 and was educated at Geneva, in Switzerland. On his father's death he carried on the business for a time, but after a disappointment in love, entered the British army, and in 1774 came to Canada to join his regiment. He was captured in 1775 and kept a prisoner by the Americans for a year. When set free, he was promoted to captain, and during 1778 was with General Howe in Philadelphia.

Under General Sir Henry Clinton he was promoted to major, and made adjutant-general. During 1779 he was with the British forces under Sir Henry Clinton in New York, where he won all hearts by his manners and his talents.

Meanwhile General Benedict Arnold had been placed in command of the fort at West Point. Arnold felt that he had been badly treated by Congress. He had enemies who had delayed his promotion, and had attempted to ruin him. While in command at Philadelphia he had married the daughter of a wealthy Loyalist and had gone deeply into debt. Somehow, at some time, the idea of betraying his country came into his mind, and this fact was made known to the British commander.

On September 20, 1780, by order of General Clinton, André went up the Hudson in the Vulture to meet Arnold. He went

ashore, wearing his uniform and bearing a flag of truce. The arrangements were not completed when morning came, and they rode to the house of a farmer near by.

It was arranged that Sir Henry Clinton should ascend the river and attack West Point. After pretending to resist, Arnold was to surrender the fort. Possibly Washington, who was then in Connecticut, might also be captured. For his treason, Arnold was to be made a British brigadier general and to receive money for the property he left in America.

The Vulture dropped downstream, and the farmer was unwilling to take André to the ship. He was, therefore, forced to try to reach New York by land. Wearing an old coat given him by the farmer, he set out on horseback. He passed beyond the American lines into what was known as the neutral ground because both parties claimed it, though neither was able to hold it. On the morning of Friday, September 23, a party of young men stopped him. André, thinking they were Tories, told them he was a British officer. They would not let him go, though he had a pass signed by Arnold. They searched him and found papers in his stockings which showed him to be a spy, and took him to an American officer, who, not believing that Arnold was a traitor, sent André to him.

Before he reached West Point, the officer became suspicious and had him brought back, but a soldier went on to inform Arnold of the capture of the man who, it was thought, had forged his name. Arnold hastily escaped to the Vulture, and reached New York in safety.

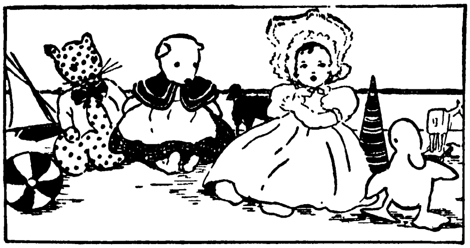
When Washington arrived, a military court was assembled, and, after hearing the evidence, condemned the unfortunate young officer to death as a spy, though all regretted to make such a decision. Sir Henry Clinton tried in vain to save his life. On the morning of October 2, 1780, the brave young man was hanged at Tappan, though he begged that he might be shot instead. In 1821 his body was removed to Westminster Abbey and a monument to his memory erected.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 4227.

Major John André standing bravely erect while the verdict of the military court is read to him, condemning him to be hanged as a British spy. The Americans made this decision regretfully.

FRENCH—*We Start on Our Trip*

First line, French; second line, English word; third line, as we say it in English.



Nos jouets—Our toys.

Nous avons beaucoup de jouets.
We have many of toys.
We have many toys.

Bébé emporte son bateau à voiles.
Baby is taking his boat with sails.
Baby is taking his sailing boat.

Jeannette emporte une jolie poupée.
Jenny is taking a pretty doll.
Jenny is taking a pretty doll.

Nos jouets sont dans la grande malle.
Our toys are in the large trunk.
Our toys are in the large trunk.

Nous faisons venir un taxi.
We make to come a taxi.
We call a taxi.

Le taxi arrive à la porte.
The taxi arrives at the door.
The taxi arrives at the door.

Le chauffeur met les bagages sur le taxi.
The driver puts the luggage on the taxi.
The driver is putting the luggage on the taxi.

Nous sommes six dans le taxi.
We are six in the taxi.
There are six of us in the taxi.

1	2	3
Un	deux	trois
One	*two*	*three*
4	5	6
quatre	cinq	six
four	*five*	*six*

Nous aimons aller en taxi.
We like to go in taxi.
We like riding in a taxi.

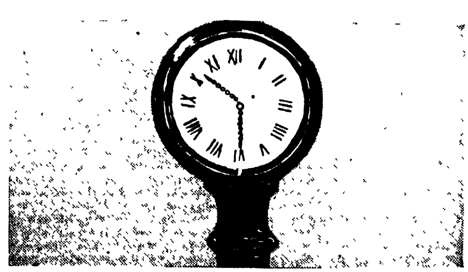
Le taxi va très bien.
The taxi goes very well.
The taxi goes very well.

La gare—The station.

Nous arriverons bientôt à la gare.
We shall arrive soon at the station.
We shall soon be at the station.

Nous sommes maintenant à la gare.
We are now at the station.
We are now at the station.

Nous nous écrions: "Quelle foule!"
We to ourselves cry: "What a crowd!"
We cry: "What a crowd!"



L'horloge—The clock.

Il y a une grande horloge à la gare.
There is a big clock at the station.
There is a big clock in the station.

Il est dix heures et demie du matin.
It is ten hours and a half of the morning.
It is half-past ten in the morning.

THE NEXT FRENCH STORY IS ON PAGE 4276.

PLASTICS

THINGS THAT ARE NOT WHAT THEY SEEM

THERE are many uses to which we can put a piece of wood. The inventor can use it to make a new kind of coat hanger, the expert carver can whittle it into a flute, the child can attach a sail and set the wood floating in water, the working man can use the wood as a lever to move a heavy crate; but despite these varied uses the wood remains wood.

The chemist takes this wood and changes it into a textile material, rayon; or he transforms it into an artificial sponge that is better and longer lasting than natural sponge; or he may make the wood provide a superior finish for automobiles and refrigerators; or he may convert it into any of a long list of different and useful things. When the chemist has finished with it, the wood is no longer wood, but something else.

Just as the bricklayer can build either a schoolhouse or a jail from the same pile of bricks and mortar, so can the chemist erect different chemical structures by using in different ways the elements which he finds in cheap and plentiful sources. Just as we combine the letters a, t, and r to spell either art, rat, or tar, so does the chemist form different chemicals by combining in different ways some of the elements taken from the chemist's alphabet, the periodic table, about which we are told in THE BOOK OF KNOWLEDGE on pages 149 to 151.

One of chemistry's greatest triumphs has been the development of a new group of materials called Plastics. Is this word strange to you? You may be sure that many of the things made from plastics have been used by you, though you may not have known them by name. The telephone receiver and mouthpiece, the handle of your toothbrush and, perhaps, the bristles themselves, the smooth knob on the gear shift handle in an automobile, the protecting layer which changes shatterable glass into safety glass, the knobs and dials on your radio receiver, to mention but a few familiar objects, are probably plastics. Several pages of this book

Courtesy, du Pont Co.

This plastic brush, with nylon bristles and "Lucite" back, is made entirely from coal, air and water.

would be required to list all the objects made from plastics.

A plastic is a substance which can be formed into a permanent shape by means of influences like heat and pressure, and which will keep its shape after the forming influences have been removed. However, substances like concrete, mud and bread dough are not plastics, even though they can be hardened into permanent shapes.

It is difficult to say just when plastics were first prepared. For many centuries experimenters who had watched the silkworm spin its cocoon and the spider its web sought gummy and sticky substances which would harden into thread-like strands. We shall begin our history of plastics with as strange a start as any great industry has ever had.

About the middle of the last century, large elephants were becoming scarce. As a result it was found increasingly difficult to obtain ivory tusks with sufficiently large diameters from which to fashion the ivory balls used in billiards. A reward of $10,000 was offered for some material which would make a satisfactory substitute for ivory.

Among the aspirants for the prize was John Wesley Hyatt of New York, a typesetter by trade, who proved to be the lucky, though unsuccessful, inventor. Hyatt, some

time before, had applied a mixture of pyroxylin and ether called collodion to a cut finger. When the ether evaporated, the pyroxylin, which is made from cotton acted on by nitric and sulphuric acids, was left behind as a smooth, durable film, fairly water and weather proof. From this experience Hyatt was led to consider pyroxylin as an ingredient for an ivory substitute. Hyatt applied heat and pressure to a mixture of pyroxylin and camphor in a mold.

THE NEW PLASTIC WAS CALLED CELLULOID

The result started a new industry, for the substance which Hyatt obtained was strong and durable when cold, and capable of being molded when hot. This new material was given the trade name "celluloid," and as early as 1869 patents were granted for its manufacture.

Celluloid proved disappointing as a material for billiard balls, but it was well suited to replace ivory and bone in combs, buttons, and a great many other articles. To-day many plastics under a variety of trade names are derived, as was celluloid, from the basic material pyroxylin, which is known chemically as cellulose nitrate.

The cellulose in cellulose nitrate comes chiefly from cotton which has been treated with nitric and sulphuric acid. Pyroxylin plastics, of which celluloid and "pyralin" are two types, are used in the manufacture of ping-pong balls, fountain pen barrels, piano keys, picture frames and scores of other articles.

Cellulose nitrate has many applications. In shoe manufacture it is used as a binder to cement on sole leather, making nailing or stitching unnecessary. In photographic film cellulose nitrate often forms the tough, transparent base on which are spread the chemicals sensitive to light. "Plastic wood" is a mixture of finely ground sawdust, camphor or some similar substance, and a solvent such as acetone. When this mixture is exposed to air, the acetone evaporates, leaving a hard product which closely resembles wood.

HOW THE FIRST SAFETY GLASS WAS MADE

The original safety glass used cellulose nitrate. In 1903 the basic principle of safety glass was discovered accidentally by a French chemist, Dr. Edouard Benedictus, who dropped a bottle that had once contained collodion on the floor of his laboratory. He picked up the bottle and found that a dried film of collodion on the inside held the pieces together, though the bottle was badly cracked.

Soon after, Dr. Benedictus witnessed a taxicab accident in which a young lady passenger was severely cut by the broken flying glass. He resolved to make glass safe and was successful in his attempt. However, patent rights were first obtained by John Wood, an Englishman, who invented a process for binding together by heat and pressure two layers of glass with a layer of plastic material, like cellulose nitrate, between them. Cellulose nitrate has since been replaced in safety glass by new plastics which are stronger, clearer, more elastic and more resistant to the harmful influences of heat, light and moisture.

The ease with which it may be molded, the many colors which it can be given, and the readiness with which parts may be cemented together or to other materials are important factors in the extensive use of cellulose nitrate. The low temperature at which it burns is a serious disadvantage.

CURVED WINDSHIELDS ON AIRPLANES

Cellulose can be treated in a different chemical way to give another useful plastic, cellulose acetate, which resembles cellulose nitrate in many of its properties. Cellulose acetate, however, does not burn so easily nor so rapidly as cellulose nitrate. Hence, safety photographic film for use in homes and hospitals is made from cellulose acetate. It is often used as the plastic layer in safety glass. Transparent sheets of cellulose acetate without any glass are commonly used on airplanes as curved windshields to reduce wind resistance and to eliminate the danger of shattered glass in case of an accident.

In another form cellulose acetate is well known as rayon acetate. We can read the complete story of cellulose in The Book of Knowledge, pages 2747-2755.

SOME PLASTICS FROM NATURAL RESINS

Not all plastics are made in the laboratory. We are no doubt familiar with substances like shellac, rosin, asphalt and pitch, though we may not have known that these are plastic materials called the natural resins.

Shellac is an animal product. The basic material comes from an insect which feeds upon certain trees in India and southern Asia. After feeding, the insect produces through its pores a gummy substance which hardens into a protective covering called lac. This lac is collected and then it is crushed,

washed and dried. After further treatment, it is skillfully drawn into thin sheets of finished shellac. Many products such as phonograph records, sealing wax, fireworks, and electrical insulators and instruments have shellac in their composition. When mixed with alcohol, shellac forms the ordinary varnish.

RESINS WHICH THE TREES GIVE US

Most natural resins used commercially come from trees of various types growing in different parts of the world. When the bark of these trees is cut, a gummy material pours through the wound. Turpentine is obtained in this manner from many cone-bearing trees. The so-called Canada-balsam is a true turpentine. When turpentine is distilled, rosin is left behind as a solid substance.

These natural resins of vegetable origin are used to form many molded objects. The resins are mixed with suitable materials. The mixture is placed in a mold under heat and pressure, and after cooling the shaped article is removed in finished form.

The mineral kingdom also provides us with natural resins called the mineral resins. Asphalt, pitch and tar are three familiar examples of this type of resin. Mineral resins are mixed with materials like asbestos in the preparation of so-called "cold-molded" plastics. The material is placed in molds under pressure and is quickly formed. Electrical parts, handles, knobs, dials and similar objects are formed by cold-molding, which offers advantages when the number of pieces to be formed is comparatively small.

The natural resins are frequently mixed with natural waxes like beeswax, carnauba wax from the leaves of a Brazilian pine, and montan wax from peat and brown coal. Such a mixture provides a good plastic material for molding or casting at low temperatures. The natural waxes are used in floor waxes and polishes, phonograph records, electrical insulation compositions and for waterproofing textiles and wood.

RESINS MADE IN THE LABORATORY

Unlike the natural resins, the synthetic resins are laboratory products, made usually from simple chemicals and materials. The synthetic resins have many desirable characteristics. They are good electrical insulators; resist corrosion and chemical action; can readily be formed into intricate shapes

Here we see a transparent layer of plastic material as it is about to be placed between two sheets of plate glass. After heat and pressure are applied, this "sandwich" will become safety glass.

Courtesy, Ford Motor Co.

with great uniformity; have high strength and hardness; and can be given a variety of colors and finishes.

HOW BAKELITE GOT ITS NAME

Perhaps the most familiar synthetic resin product was developed commercially in 1907 by Leo Hendrik Baekeland, a Belgian-born chemist who did much work in the United States. From his name was derived the trade name Bakelite. This plastic is now made by several companies under many trade names.

Bakelite and plastics like it have two basic ingredients: phenol, which is a coal tar product, and formaldehyde, which is usually obtained from one form of alcohol. When allowed to react at a suitable temperature, the phenol and formaldehyde yield a clear amber-colored solid. This is called the primary or A stage. Further heating changes the chemical constitution of this solid into a permanently hard substance which can resist almost all chemical attacks. The chemical change which takes place is known as *polymerization*.

When similar molecules are combined in such a way that the result is a new molecule which contains all the atoms of the original molecules, polymerization has occurred. This is much like taking the two similar words "tar" and "tar" and combining them into one word, "tartar," which contains all the letters of both our original words. Just as tartar has a different meaning from tar, so does the polymerized molecule have different chemical properties from the simpler molecules which form it.

In the production of articles, the phenol-formaldehyde combination in the solid primary stage is ground into a fine powder and is mixed with any desired fillers or coloring materials, and is pressed into molds of the desired shape. Heat and pressure are applied which cause the powder to change its form. A thin-walled object may be molded in less than a minute. These resins can also be cast, and the larger pieces are usually made in this way. You have seen some of them.

BUILDING PRODUCTS LAYER BY LAYER

This plastic also lends itself to lamination, a process whereby layers are built up into the desired final shape. The plastic in the primary stage is dissolved in solvents like alcohol or acetone to form a lacquer. The lacquer is then applied to a material such as paper or cloth. After the solvent has evaporated, leaving the synthetic resin behind it, the impregnated layers of paper or cloth are piled one on top of the other to a height which will give the desired final thickness. These layers are then placed in a hydraulic press and heat and pressure are applied. In this way hard, dense plates are produced.

The properties of the finished product will depend on the amount of resin used and the type of cloth or paper. Laminated products are employed to make radio cabinets, modern store fronts, table tops and gears, which in many uses outlast steel and are practically noiseless in operation.

Other combinations of chemicals form plastic materials which are similar to the phenol-formaldehyde type. Urea and formaldehyde are used to make a plastic which lends itself to formation in light colors. Urea was the first organic substance to be made in the laboratory. It is obtained from two gases, ammonia and carbon dioxid, while formaldehyde is made synthetically from carbon monoxid and hydrogen, both gases. Thus, four gases are used to make a hard solid material. These four gases, in turn, are made from three common materials, air, carbon and water.

The urea-formaldehyde plastics are tasteless, odorless and resist corrosion by water. These properties have made them popular for drinking tumblers and other tableware. Buttons, buckles and automobile fixtures are also made from this plastic.

A RUBBER-LIKE PLASTIC FROM COAL, LIMESTONE AND SALT

Neoprene is the commercial name for a rubber-like plastic which is superior to natural rubber in many respects. Coal, limestone and salt provide the raw materials for neoprene. A German product, Buna, is another rubber-like plastic.

Though at present more expensive than natural rubber, neoprene is used in increasing amounts because it resists oils, heat, sunlight and many other chemicals and conditions which quickly render natural rubber useless. Neoprene and Buna differ from natural rubber in their chemical composition.

LUCITE, MADE FROM COAL, AIR AND WATER

Lucite is a plastic with unusual optical properties. Lucite is an offspring of coal, air and water. It is crystal-clear, light in weight, and difficult to break or shatter. A solid tube of Lucite carries light from one end to the other, even though it be bent like a corkscrew or pretzel. This property has been put to use in surgical and dental instruments.

Courtesy, du Pont Co.

This picture shows the sheerness of hosiery made of yarn spun from nylon, a protein-like plastic material which is obtained from coal, air and water. Nylon yarn has a high degree of strength and stretch.

It is likely that your doctor has at some time stuck a piece of flat wood called a tongue depressor into your mouth and has asked you to say "ah." These tongue depressors can now be made of Lucite with a small electric light applied to the base. When the tongue is pressed down, the cool light flowing through the Lucite comes out at the tip and illuminates the parts of the mouth and throat which the doctor wishes to see.

Lucite reflectors which cast back the light from automobile headlights are used to light up stretches of highway at night for safer driving. These reflectors have many times the light reflecting ability of similar disks made of pressed glass. Jewelry and ornaments are made from Lucite, which lends itself to this use by its crystal clarity.

Protein plastics are becoming increasingly familiar. Common protein products like casein from skimmed milk and soy-bean meal from soy-beans provide the raw materials.

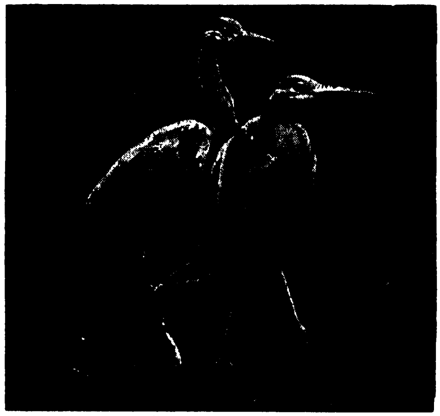
The protein substances are thoroughly ground and kneaded. They are then passed into suitable presses or other devices which form them into sheets, rods, or tubes. The formed pieces are hardened by treatment with formaldehyde. The hardened material is cut into finished products like buttons, beads, buckles and game counters. The soybean now grown extensively in this country furnishes much of the plastic material used in automobiles for the steering wheel, the gear shift knob and other parts.

Plastics have provided us with many entirely new materials for old and new uses. Formerly the chemist tried to imitate nature; now the chemist produces in his laboratory products which never before were formed or known. (Rayon for many years was called "artificial silk." It was given its own name, rayon, only when it was recognized as a new and desirable material which was unlike silk and which possessed its own valuable properties.) This tendency to recognize plastics as new substances and not as imitations has helped to promote research and invention. The future of plastics, we may be sure, will bring us developments which will far outshadow the achievements of the past and present. Though much has already been done, we can say that plastics offer an exciting field for the interested boys and girls who wish to make chemistry and its practical applications their life-work.

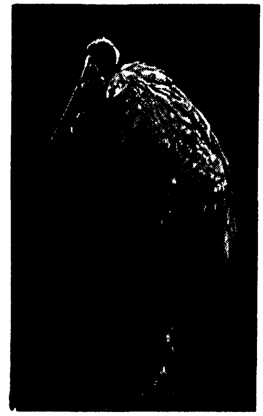
THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4051.

THE STORKS AND THEIR COUSINS

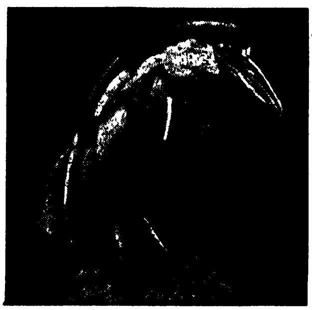
The Indian adjutant.



Common herons.



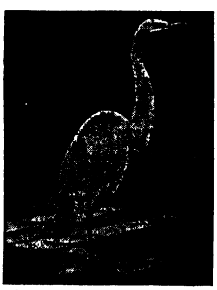
The American jabiru.



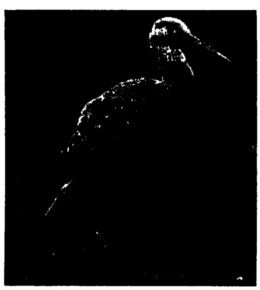
The boatbill.

The sand ibis.

The night heron.

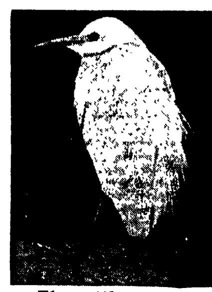


Great American egret.



The white stork.

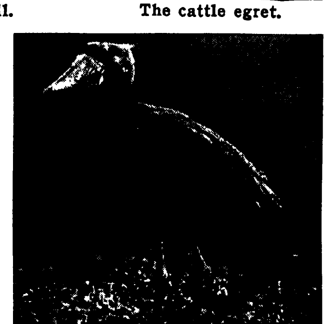
The spoonbill.



The cattle egret.

The hammerhead.

The Squacco heron.



The whale-headed stork.

The Trumpeter.

The Great Bustard.

The Bengal Florican.

HERONS, STORKS AND CRANES

ONE of the disadvantages of our civilization is that too often stress of circumstances places square pegs in round holes in the artificial economy of our lives. A man of splendid frame, who should be exploring the wilds, must sit at a desk; a brain teeming with fine imagination is deadened by routine work in a factory.

Nature never practices such misfit politics. Life and environment fit like a hand into a glove. She obliterates her failures: the quiet bosom of the earth is sown with them. But the successes survive, to make us marvel that Nature is always so efficient where we stumble and halt.

But the tragedies we create for our own kind extend little by little into Nature's province. We are making round holes for her living square pegs. We are growing grain where she grew marsh birds; we are building houses where she set cranes and herons to preside; we are reclaiming fens and moors where her long-beaked beauties once were owners; we raise houses on which storks nest where for a thousand ages storks nested in the wilds.

The old law is still in operation, however, though our lives are too brief to see from the beginning to the end of the chapter. The birds which adapt themselves to the changes effected by man will go on flourishing; the birds which cannot mold their lives to new forms will join the long line of the dead which have left no posterity. Let us be thankful that some of the most interesting birds we have are adapting themselves to conditions which the wisest of humans could never have predicted.

Most people must take the heron very much on trust. This bird has become very rare in Europe. There are high trees where herons nest still in England, but the secret is too precious for publication, lest the birds should be mobbed out of existence, and the last of their eggs stolen to swell a collection.

Time was when herons were protected in England by laws as stern as those which sheltered the king's tall deer. Not mercy but sport was the motive; for herons were fearsome game at which to fly a hawk. For the heron, with its long and powerful beak and the supple, muscular neck which supports and propels it, is dangerous when attacked. If attacked in the air, it strives for the upper position, like a human aviator; when its enemy is above it, it poises its terrific beak and stabs with sufficient force to impale its foe. Once when a hawk battled for

half an hour with a European heron the superb tactics of the heron prevailed, and it was the bird of prey which gave up the fight and took refuge in retreat.

THE CROW THAT ATTACKED A HERON AND CONQUERED

Even a stranger sight was noted a few years ago in a great city. There a heron's assailant was an audacious crow. The black brigand soared and manœuvred magnificently, and twice got the advantage of height, and presently he made such a swoop at his quarry that the two birds crashed together into the trees on the side of a park.

The crow did not wish to eat the heron: that was too big a meal. He was simply carrying out in the city the trick of the piratical frigate bird against the booby in the Pacific; it was trying to make the heron disgorge the fish it was carrying home in its crop for its nestlings.

For fish are the mainstay of the heron. See it standing on one leg in the water, eyeing the deeps with anxious gaze. So still it rests that it might be the statue of a heron, and not a living bird. But intense activity suddenly succeeds to immobility. The second leg appears, the great bill flashes into the water faster than a swordsman's weapon, and up comes a fish, speared, as a rule, though the bird will sometimes catch its prey as a flycatcher grasps an insect.

THE VARIED DIET OF THE HERON AND THE SOLUTION OF A MYSTERY

Water-rats, frogs, newts and young birds come acceptably to a heron's appetite. As these are undoubted enemies of trout, herons, for all their hunger in a stream, are really friends of the fisherman. They keep down the coarse fish which devour the eggs and little trout, and it must be only the slowest and least healthy trout that fall to the birds, so they have their value even there.

A charming fact was revealed to the credit of these birds by a great naturalist. It had been a mystery to botanists how certain great water-lilies became distributed from one far isolated lake to another. The seeds are fat and heavy; they could not be wind-borne; they could not travel by water from lakes which have no outlet. It is the herons that achieve the little marvel. They eat the fish which have eaten of the seeds, and, flying from one lake to another, pass the unharmed seeds from their crops into the water, and so enable these floral beauties of the lakes to be fruitful and multiply.

It is not pleasant to watch parent herons feeding their young—to see rats and eels and fish returned from the adult gullet; but the affectionate fidelity of the elders to the helpless ugly youngsters in the nest is in itself a charming trait.

Then, if we let the eye follow the old birds after they leave the nest, their powerful flight, suddenly accelerated by fear into a majestic upward sweep sheer into the heavens, the unpleasant spectacle of the feeding is forgotten in our delight and admiration at this tremendous upsoaring. To say that no airplane can rise vertically like it is to put the fact in an undertone; for the hawk itself can but sweep round in rising circles, while the heron is mounting like a rocket.

THE HERONS IN DIFFERENT PARTS OF THE WORLD

The largest of the flying waders of Europe is the gray heron. The Night Heron, which hunts when ordinary birds are sleeping, is common in many parts of the New World as well as in Europe, Asia and Africa. It is so bold and so clever that it colonizes the nests of the great eider duck, and makes its nest in the side of that of its host.

The Gray Heron measures about thirty-six inches, but the Goliath of the tribe is half as large again. It is mainly an African species, though known in Ceylon, and sometimes seen in numbers in India. Very weird and fantastic the Goliath Heron looks in its breeding plumage, a living caricature of what we should expect so neat and comely a type of bird to be.

Nuptial plumage is strikingly developed in the Great White Heron of the West Indies and Florida. Its yellow beak turns black during the season in which it desires to seem handsomest in the eyes of its mate. At the same time long filament-like feathers appear on the back, while those on the lower part at the front of the neck become luxuriant. But it is that small group of herons known as White Egrets that are most famous, and sadly famous at that, because of these festival feathers.

The distribution of these birds is so widespread—in Southeastern Europe, many parts of Africa and Asia, and in North and South America—that their place in life should be as well established

as that of the starling. But it has received a gift of beauty which is becoming fatal to its continued existence.

THE LITTLE BIRDS THAT ARE STARVED TO DEATH TO MAKE A WOMAN'S HAT

At mating-time the parent egrets are splendid in exquisite, delicate feathers adorning the base of the neck. Heartless women covet these for use in their hats, and hosts of these lovely creatures are slaughtered for fashion's sake. Parenthood should be a bond of tender sympathy throughout all the kingdoms of life, and women should be ashamed to wear these plumes when it is known that to obtain them the parents must be stripped and left to die at the very time when their little ones need their aid.

The sale of these plumes is forbidden, yet the fact that men risk heavy fines to smuggle them in shows that there is still a demand for them. As long as there are cruel people there will be cruelty, and only time, perhaps, will put an end to the shameless fashion which is willing for lovely birds to be extinguished, for thousands of young birds to perish of starvation, for the sake of a woman's hat.

THE VALUE OF THE LITTLE EGRET TO ONE OF OUR GREAT INDUSTRIES

Fortunately commerce is now ranged with humanity against this barbarous fashion. The fact that the egrets are destroyers of insects which spread the deadly sleeping sickness and other diseases in the tropics did not move the creators of fashion, but something has stirred the mind of manufacturers. It has been found that the egret is the natural protector of the cotton plant.

The boll-weevil is threatening all supplies of cotton, and the weevil is food to the birds. So "cotton is king" indeed when it decrees that the little egret must live in order that one of the greatest menaces to prosperity may die. Once more the appeal to the pocket has prevailed.

Other herons found in North America are: the Reddish Egret, the Louisiana Heron, the Little Blue, the Green and Ward's Heron, a large blue heron found in Florida. The Night Heron has two species—the Black-crowned and the Yellow-crowned. Most of these belong to the warmer regions of the continent, though they sometimes straggle northward.

Next we come to the Bitterns, which are clearly akin to the herons. Bitterns nest in solitary fashion, here and there in the marshes, not in colonies like the herons. The American Bittern resembles the Common Bittern of Europe, but is smaller. It is found throughout the continent except in the Far North. The noise it sometimes makes has been compared to the bellowing of a bull, or to the noise made by an old wooden pump. It was formerly believed that the bird struck its bill into the water while booming, but this has been disproved.

Neither the larger nor the smaller bitterns can be said to be common. When attacked they fight viciously, and their sharp beaks may inflict severe wounds. In addition to the larger species we have the Least Bittern and Cory's Least Bittern, both of which breed as far north as Ontario.

The Little Bittern belongs to wilder lands, and the same melancholy fact has to be recorded of the common bittern. This stealthy wonder of bird life, with its marvelous adaptation to the broken lights of reed bed and high-grown marsh, where it matches as famously as the tiger in a jungle setting, was once abundant in our land. But fens feed men where bitterns lurked, and the advance of cultivation is disaster to birds whose shyness makes the approach of mortals terrible.

The American bittern is sometimes over thirty inches in length, and though it is a model of elusiveness in its hiding places, it has not the faculty of the rails and corn crakes for concealment after discovery, but rises, when alarmed out of its attempt to resemble dead rushes and reeds, climbs into the air, and is shot or struck down before it can get out of range.

THE SHY BITTERN THAT HAS BEEN DRIVEN FROM ITS HOME

Bitterns were so persecuted by gunners in England that for many years they were afraid to breed in that country. Of late, however, they have returned and are now to be numbered among the summer birds of Norfolk County.

We have dealt, so far, with birds whose beaks are long, pointed, and ideal implements for the jabbing movement which is fatal to prey—and to human eyes if we approach too near. But now we change to a bird, the Boat-billed Heron, in which the beak attains a striking development in breadth. This is a South American species, frequenting the shores and living chiefly on small shellfish.

The Hammerhead, so called from the shape of its skull and beak, reproduces features of both herons and storks, but is more proficient and cunning than either as a home-maker. Its nest, constructed very strongly of huge domes of sticks, consists of three chambers. The lowest serves as a lookout post; the top story receives the eggs and serves for sleeping-quarters in case of flood; the second houses the young when they are too large to remain in the nursery upstairs.

Beauty, strength, and much that is repulsive to human standards meet in the Storks, which are birds of the Old World. All have great straight pointed beaks of immense power; all are long-legged, with many rough, unkempt feathers; and nearly all enter willingly into partnership with man. The Great White Stork of Europe is a watchdog whose kennel is not in the yard, but up on the roof of the house, with the chimney for foundation, or a box, or even a cart wheel turned on its side, laid there by man. On this the birds rear ambitious structures of sticks and branches, which are renewed year after year.

Tradition enshrines hosts of charming stories about storks, and the birds are received with favor practically everywhere. They are supposed to bring good luck. Probably the superstition arose from the fact that the great birds are lusty devourers of garbage and carrion. They play the part of jackals in feathers, and their labors to satisfy their appetites must be conducive to the health of the places which they clean up.

THE STRIKING FAITHFULNESS OF THE STORK TO ITS FAMILY

But beyond this there is the fact that the stork is among the most faithful of birds to its kind. Its devotion to its mate and its young has many touching examples, though some of the stories told are pure fancy. Still, when we know that a stork stayed for three winters in succession on a Dutch roof rather than desert its mate, we know that the good nature of the bird is a fact. The explanation of the conduct of this pair was found to be that an injury to the hen prevented her from flying far, so her mate remained all that time with her, denying instinct, refusing the call of the sunny South, for affection's sake.

The best-known storks are the White, which has black about it; the White-bellied, marked not unlike the so-called Black Stork, which is white beneath; and the three big species known as the Jabirus; and the Marabou, or Adjutant, Stork.

The Marabous are the giants of the tribe, and hideous. The strong, thick neck is naked, and in two species this peculiarity is unpleasantly emphasized. The great head is bare or sparsely covered with a woolly-looking, ugly down, and the whole appearance of the adjutant, as the bird is called from its military strut, brings to mind a vulture in caricature. However, some of its feathers are highly prized as trimming.

In tropical Asia and Africa the birds are prized as scavengers. They will eat carrion, they will gulp down live puppies or dead cats, banquet on fish or bird, and enjoy themselves like epicures on the offal that a hyena might suspect.

THE WORK OF THE MARABOU AS A SCAVENGER

The high value of such habits in a bird among people whose practice is to litter the streets with refuse dangerous to health is, of course, easy to understand, and in places the marabou is protected by law. It is the only protection the bird needs, for among vultures and other rivals it pecks its way persistently to victory. The Jabiru, found in tropical America, occasionally ventures into Texas. It is a very large white bird with neck and head bare.

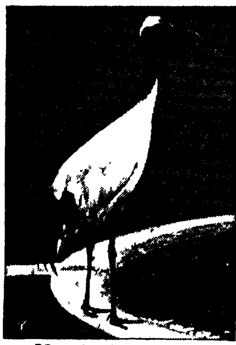
Storks, which hunt in company, often show the cunning of pelicans in combining to round-up shoals of fish, but the habit of the Wood Storks is the most singular. Fish and water reptiles are the food of this species, which belongs to the warmer parts of the Americas. The birds enter the water in company, and, on discovering life in it, set up a prodigious dancing. The effect is to convert the clear stream or lake into a mud-pool and to cause its inhabitants to rise—the fish to clearer water, the young alligators and other reptiles to see and to breathe the open air.

As the swarms appear at the surface, stab, stab, stab! go the beaks of the wood storks. At each blow some living thing is maimed, but not eaten. Not until all the rising life has been thus treated and the whole floats prostrate in sight do the birds begin their feast. When nothing else swims to challenge attention, the storks then return to the floating wounded and gobble.

WHY THE IBIS HAS A LONG CURVED BILL

In some quarters these wood storks are called ibises, but there can be no mistaking the true Ibis, thanks to a peculiarity. The long, down-curving beak is soft for part of its length, though rigid horn at the tip, a feature unknown among the storks. The ibis is a prodder in the mud of lake and river, hence its long curved bill.

There are some thirty species of ibises scattered about the warm countries of the world. That which we call the Sacred Ibis has its counterpart in Africa, in Madagascar, in Australasia and in Asia; but not in Egypt, where for ages and ages, while pharaohs waxed and waned, this bird was an object of worship. Yet not a sacred ibis is to be found in Egypt to-day. Kindly protection of the birds seems to have died with the superstition which made the ibis immune from harm by mortal hand.


Manchurian Crane.


Balearic Crane.


Cape-crowned Crane.


Australian Cranes.


Asiatic White Crane.


Common Crane.


Great Courlan.


Demoiselle Crane.

Several species of ibis are found on this continent. The outer feathers of the wings of the White Ibis have black tips. This bird lives in flocks and is the common species. The Scarlet Ibis, the Glossy Ibis, which is bright chestnut in color, and the White-faced Glassy Ibis are rare. Nearly allied are the Spoonbills. The White Spoonbill was formerly common in Europe but is becoming rare. Our Roseate Spoonbill is a resident of warmer America. It has been unsparingly hunted for its feathers and has become very rare.

The Bustards, which follow the spoonbills in the family tree, are birds of the Old World. They run and walk unweariedly, they fly splendidly, they are big and lusty, though their bills are comparatively short. Anything vegetable, from seeds to herbage, anything living, from grasshopper to small lizard, forms their menu. But they needed for their flocks and for their quiet nesting pairs the sanctuary of open moor and plain, and distances undisturbed like those of the boundless steppes of Asia.

They have vanished from England, except as the rarest of rare visitors during summer days. In fact, they have become uncommon in Europe. Nearly two score species of these fine birds are spread about the Old World, but for ourselves we must seek sight of them alive in zoos, stuffed in museums and private collections.

The sandy heaths of England and Holland still support the Stone Curlews, or Thick-knees, as they are perhaps more properly called. They come next in affinity to the bustards, but are smaller. Their first name is derived from a resemblance in size and plumage to the common curlew, and their second from a curious thickening about the knees, as if the birds

suffered from enlargement of the joints. They are birds of great value, working mainly in the dark to clear open spaces of field-mice and reptiles. Their range extends to North Africa and India.

We have to turn to South America for their nearest allies, the Seriemas and Trumpeters. The Seriemas, long-legged, long-necked, rather bittern-like, and very upright in gait, bark like dogs, eat snakes and other reptiles, young rats and mice, and do their hunting in the New World, like the thick-knee of the Old, when darkness sets in.

Following them must come those doubtful birds the Trumpeters, another South American form of grace and notable characteristics. In form they are likened to long-legged guinea-fowl of blackish hue, but in voice they are themselves only, uttering their clarion calls in the night, a full sixty seconds to a single blast. How different from their friends the storks, which have no voice, but talk, if they talk at all, only by snapping together the two halves of their great beaks!

THE GRACEFUL CRANE AS THE FRIEND AND ENEMY OF MAN

The Old World has neither seriemas nor trumpeters, but she has nearly all the Cranes, of which there are nearly twenty species. Here the legs and graceful neck are long, and the beak is big, compared with that of the bustard, but insignificant in contrast with that of the herons and stork. They generally keep to marshes or wide plains, migrate over long distances, and fly with grace and endurance.

The Demoiselle Crane, the Crested Crane, the Manchurian and the Common Crane are superb creatures, and the Manchurian must be specially noted as the bird that figures in much of Japanese art on screens, fans, and a thousand other curious objects. We have three species—the Whooping, or White, Crane; the Sandhill, or Brown; and the Little Brown Crane. The first is the largest bird we have, and has a wide range, while the second is more common in the South, and the third in the West.

Generally the cranes are seed-eaters, though they eat frogs and lizards as well. They must serve us well in the number of injurious growths whose spread is prevented by this destruction of seed. But in districts where cultivation is relatively new, and cranes are one of Nature's ancient institutions, the birds do great damage to crops. They have not abandoned their old haunts to which men have come. They go back, and, finding a new food prepared for them, harvest it in a way not contemplated by the sowers.

A rare heron-like bird is the curious stunted Kagu, notable for the streaming tuft of feathers springing from the back of the head. Its home is New Caledonia; its closest cousin is the South American sun bittern, a beauty of the swamps, delighting to recline with lovely feathers vaingloriously outspread in the sunshine, and looking like some wonderful great butterfly when in flight.

THE PLOVER THAT DOES SO MUCH GOOD IN OUR FIELDS

We march on now into another family of birds, the birds which resemble plovers. The Pratincoles are birds of the Old World. Their tails are forked like those of swallows, and they catch insects in full flight. The swift-running, long-winged desert birds, the Coursers, find their meat in grubs and insects from the sands.

Then there are the birds of the true Plover Family itself. A most admirable family is here, birds which pick up a living anywhere, on the bleak mountain side, in the fields, on the heaths, by the brink of the sounding sea. It is a large family of almost a hundred species, though we have only eight—the Golden Plover, which is found all over the world, the Killdeer, the Piping Plover, the Black-bellied, the Mountain, the Snowy, the Semi-palmated and Wilson's Plover. Some of these feed largely on land and destroy many insects.

Nobody who loves our countryside should hurt a plover, and no true friend of agriculture would ever eat a plover's egg. How well the plovers protect their nestlings, rising into the air from the nursery, fluttering a little way, then running as if with broken wing or leg, simply to lure the fowler from the babies in the little cradle.

THE WRYBILL, AND HOW IT CAPTURES HIDING INSECTS

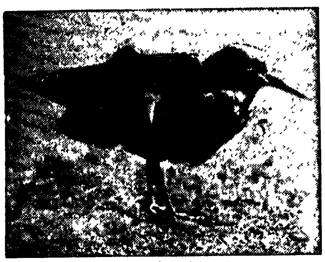
New Zealand's famous Wrybill is simply a plover with a curious curved beak, an instrument fashioned so that this little wonder may use its bill to pick out the insects which seek to avoid capture by lurking behind stones. Stilts, aptly named from their stilt-like legs, are classed as plovers by some naturalists, as are also the avocets and oyster-catch-

A GROUP OF GOOD BIRD FRIENDS

The snipe.

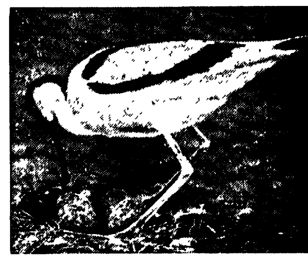
The whimbrel.

The curlew.



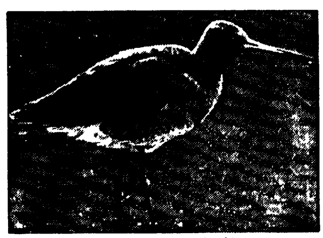
The knot.

The ruff.



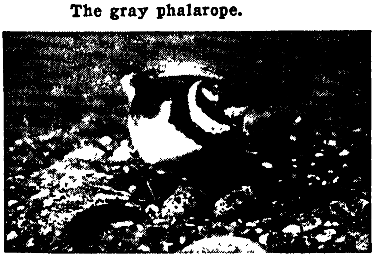
The avocet.

The gray phalarope.

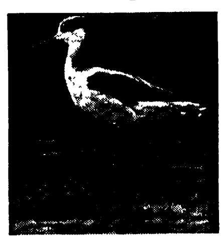


Black-tailed godwit.

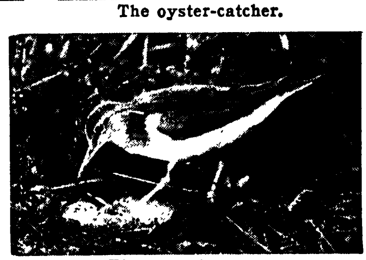
The oyster-catcher.



The ringed plover.

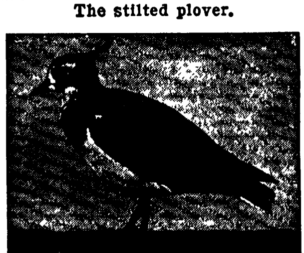


The stilted plover.

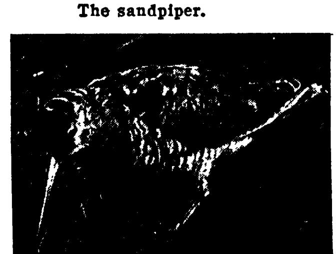


The sandpiper.

The sanderling.



The lapwing.



The woodcock.

The pictures on these pages are by Mrs. M. H. Crawford, Messrs. A. Brook, Coles Finch, E. W Tayler, and others.

ers, though other students place them in another family. Avocets are beautiful birds of the marsh, lagoon and estuary. The Oyster-catchers live on the shore and work some way up the rivers. They are masters of the art of opening the shells of bivalves which resist all the strength and cunning of a man dependent for success on the use of his hands alone.

Closely related are the Curlews with bill as much arched downward as that of the avocet is curved in the opposite direction. Here is an inland-nesting bird which summers by the sea, but, wherever it is, constitutes itself the guardian of all life around it by raising an alarm at the coming of danger, not only to its own kind, but even swooping down with its piercing anxious cry on sleeping seals to which a dreaded man is seen advancing. A wonderful creature is this solicitous curlew. There are more than fifteen species, of which we have three—the Long-billed, the Hudsonian, which breeds in the Arctic regions, and the Eskimo, likewise a northern bird. It is often found in dry fields.

We find boldness in another form in the Phalaropes. There are three species, all found in North America. The Red Phalarope and the Northern Phalarope are found in Europe also, but Wilson's Phalarope belongs to America. Their boldness reveals itself in the manner in which, when shifts for a living are not well rewarded on the shore, they boldly take to the water and swim for their food.

THE COUSIN OF THE SANDPIPER WITH ITS SHOWY RUFF

Next come the Sandpipers, of which more than a dozen species are found in North America. Some are large, some small. They have little webbing between the toes, but all have web places and both run and fly gracefully. Their colors are gray, brown and yellow. They are brave and lovable little birds.

A bird which might be mistaken for a sandpiper, but which develops at the courting season into a very different plumage, is the sandpiper's cousin the Ruff, common in Europe and occasionally found in America. It is the great showy ruff round the neck of the male which confers the name. The female is always much of sandpiper hue and fashion, but the male, when he is displaying before his lady-love, is one of the show creatures of birddom.

Two related birds, the Godwits and the Turnstones, are among the greatest of travelers. The eastern species of the godwits pass down to Australia for the winter, and the turnstones, which have flown from the Far South to raise their babies on food snatched from hiding beneath the shore stones of the Arctic, pass down again as far as New Zealand when winter storms frown in our hemisphere. Knot, Stint and Sanderling are others of the birds that find rich harvests among the sea-fields that lie between high tide and low.

HOW THE MIGRATING WOODCOCK CARRIES ITS YOUNG

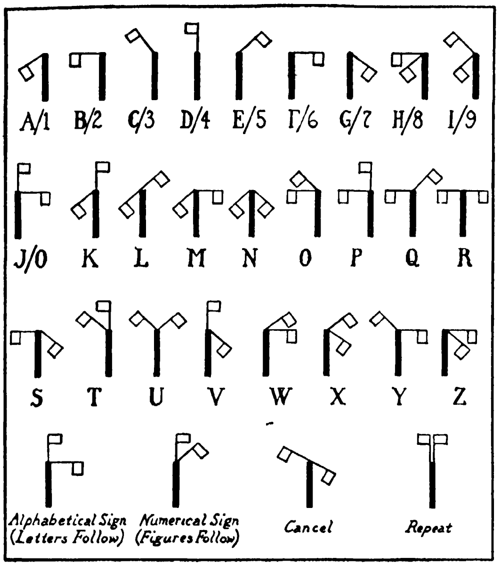
Thoughts of travel suggest that wonderful snipe, the Woodcock, which is devoted to its young. The European species is said to carry off its young to a place of safety. The American Woodcock resembles its European cousin very closely. There are several species of snipe, but none more interesting than the common species whose so-called "drumming" always has been something of a mystery, and so remains. The noise is made only at courting time. Then the males rise into the air in curious circling flight, and suddenly plunge to earth with half-closed vibrating wings. It is this wing motion, so far as can be ascertained, which produces the drumming, a note likened to the bleating of a goat.

Many of the little friends of the plover tribe approach the characteristics of the moorhens, but none so closely as the Jacanas, or Water-pheasants. All ten species are tropical, long-legged, slender, and extraordinarily long-toed. These remarkable feet give the bird its right of way through life, literally on lilies. The jacana upon its widespread long toes, steps daintily from lily-leaf to lily-leaf, secure as a man crossing a bridge. One species comes into the United States from Mexico.

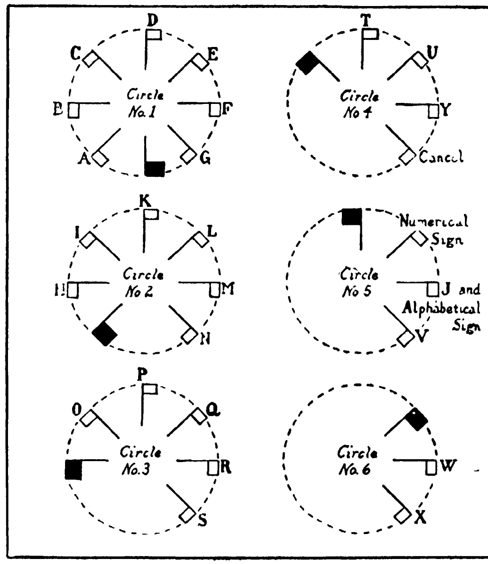
WHY WE MUST ALWAYS BE KIND TO OUR FEATHERED FRIENDS

Nature and the jacana have agreed extremely well, and man has not yet interfered to spoil the little paradise. For the rest, we have broken in on many an idyllic solitude, ringed about many a one-time Eden of birds. Some have vanished like the Arabs of the poem; some have fought like wild things for that of which they have been dispossessed; but others have taken us into their friendship, and, like the storks on the housetops and the adjutants in the villages, have staked their all in partnership with us.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 4121.



1. Letters and signs of the flag alphabet.



2. The flag alphabet shown in circles.

HOW TO SPEAK BY SIGNS

THE method of signaling or flag-wagging that we are going to show you in this article is a splendid way to exchange messages with those who are far beyond shouting distance but still in sight. The apparatus for signaling is very simple. It may be manufactured in a few seconds from two white pocket handkerchiefs, fastened on sticks.

The letters of the signaling alphabet are shown in the pictures on this page. Imagine the thick lines to represent the body of the person signaling and the thin lines to represent the flags held in the hands. For example, the letter A is represented by holding the right-hand flag as if it were pointing to the VII or VIII marks of a clock-dial, assuming the feet of the signaler to be at VI and the head to be at XII. When only one flag is shown, as in the case of A, the second flag is to be held pointing directly to the feet of the signaler.

It would be good practice for you to write the alphabet signals on a piece of paper, beginning by writing out the entire alphabet a few times and then by writing different letters at random, without consulting your signaling alphabet. Later you can write out entire words, and soon you will be ready to send messages to your friends.

Another way to assist your memory is to study certain circles of flags. Looking at circle No. 1 on this page, you see that A, B, C, D, E, F and G are signaled by letting the flag in the left hand hang down in front and by changing the position of the right-hand flag. From circle No. 2 it will be seen that the letters H, I, K, L, M and N are made by holding the right-hand flag in the position of A, and by moving the left-hand flag to the positions placed opposite the letters.

Circle No. 3, which illustrates the letters O, P, Q, R and S, shows the right-hand flag at the B position and the left-hand flag moved around as indicated.

Circle No. 4 shows the letters T, U, Y and the sign for "cancel," all of which are made by keeping the right-hand flag in the C position and changing only the position of the left-hand flag.

Circle No. 5 shows the right-hand flag in the D position, where it is held when indicating the numerical sign, and also for J or the alphabetical sign and for V, the position of only the left-hand flag being changed for all these different signs.

Circle No. 6 shows that the letters W and X are indicated by holding the right-hand flag in the E position and changing the posi-

tion of the left-hand flag only. Z is not included in the circle system; the flag position for Z must be learned separately.

Probably the meaning of the words "alphabetical sign" and "numerical sign" in the picture needs some explanation. There are no special signals for the numerals. A standing for 1 and other letters for other numerals, as shown in the picture. Now if a message is to consist of letters, you are to make the signal for alphabetical signs first, thereby showing that the signs that follow are to be read as letters—A, B, C and so on. Similarly, if at the beginning or in the middle of a message the signs that are going to be made are to be read as numerals and not as letters, make the numerical sign.

The "annul" or "cancel" sign almost explains itself. It means that you wish the previous sign sent to be canceled, perhaps because you find that you have made a mistake in transmitting that particular sign.

Having seen the meaning of the various signs, you are ready to see how a message should be sent. First you stand in the "ready to start" position, with the two flags pointed downward and slightly crossed over one another; you are to face the direction in which the message is to be sent. Next move both flags to attract the attention of the person to whom you are to signal, and when you have succeeded, signal the letter J, which shows that letters, not figures, follow, before returning to the first position.

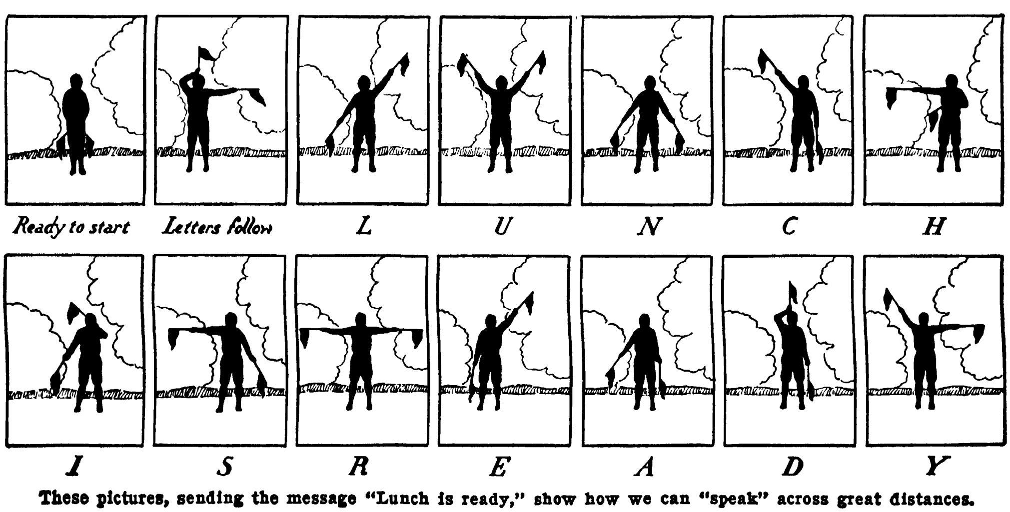
It has been seen that the letters of the signaling alphabet are formed by the various angles at which the flags are held to the body. To send a message, stretch out your arms to their full extent and hold the flags in a straight line with your arms, never allowing them to droop from the hands and never inclining them to the rear.

Be careful when signaling not to make the positions for the letters A and G too close to your body. When making the letters T, O and W and the numerical sign, keep the two flags well separated from each other.

When signaling, the flags must be kept unfurled and brought vigorously from one position to the other. The arms should be brought right in to the body between letters, the flags pointing downward. A pause must be made on each letter or number. A little longer pause should be made—the signaler standing with the flags crossed—between words.

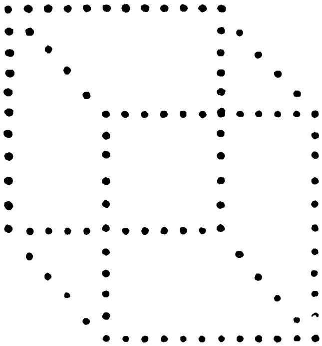
It would be well for the person receiving the message to provide himself with two signal flags. If a word fails to make sense the receiver of the message stops the signaler by raising both arms vertically to their full extent. The signaler will show that he has understood this by signaling back J. The receiver will then send the last word which he received correctly, whereupon the signaler will continue with his message from that word. If the message is long it would be well to have two receivers: one to take the actual message and the other to write down each letter or number as it is dictated by the person receiving the message.

To make your knowledge of signaling complete you should practice sending figures after you have become proficient in sending the various letters of the alphabet.

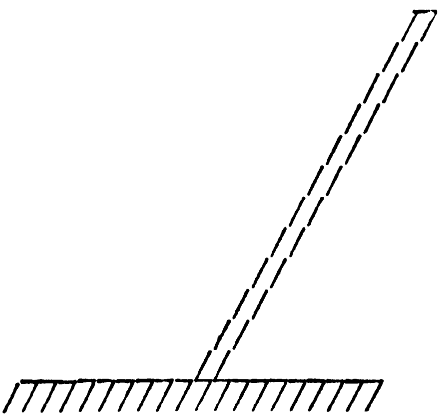


These pictures, sending the message "Lunch is ready," show how we can "speak" across great distances.

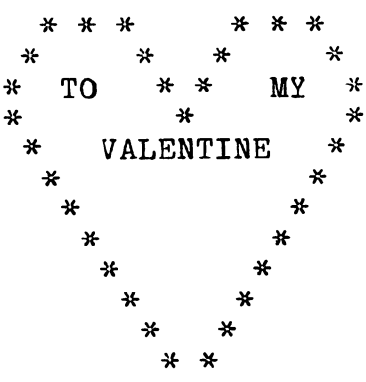
FUN WITH YOUR TYPEWRITER



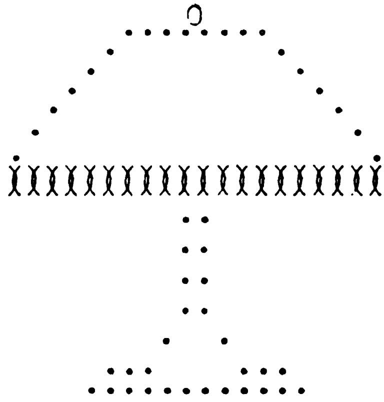
A Box. First make a square of periods, then another square of the same dimensions beginning in the centre of the first square. Complete the box by filling in the lines which join the two squares.



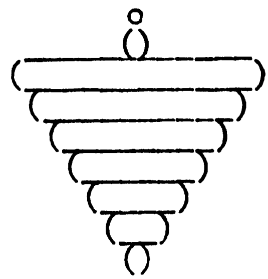
A Rake. Make the teeth with the oblique bar joining them at the top with the underline. The oblique bar is used for the handle with an underline at the top.



A Valentine. Type the word VALENTINE. Place a star over the N; work up, first a left star then a right. After completing top line work down in the same way.



A Lamp. The period and the left and right parentheses form the shade and base, a cipher the top. Fringe is made by striking the left parenthesis over the right.



A Top. Make with left and right parentheses and underline keys. Begin at the bottom and work up. At the very top is the letter "o".

A Christmas Tree. Use an asterisk for the star and apostrophes for the main part of the tree. Four lines of periods, or more, can be used to make the base.

PREPARING A PICNIC LUNCH BASKET

WHEN we go for a picnic it is best to take things which weigh as little as possible. We do not want a heavy load to tire us before we reach the spot decided on for lunch. We choose a lightly made wicker basket or a tin lunch kit or even a cardboard box for the eatables. We replace china plates by paper plates, glasses by paper cups, salt-cellars by little packets of paper containing salt and so on. As for the eatables, it is well to take things that will not spoil, crush or melt when they are wrapped up.

Hard-boiled eggs and bread and butter are very satisfying and very easy to carry. The eggs are boiled for 5 minutes and then placed in cold water for 2 or 3 minutes to harden them still more. We wrap each egg in white wax paper and we place them all in an egg-box at the bottom of the lunch basket with several packets of salt. We shall want slices of bread and butter to eat with the eggs. The slices should be cut the same size and placed with buttered sides together in a pile. Bread that has already been sliced at the bakery will be particularly good for our purpose. The bread and butter is then covered with wax paper. The eggs can be cracked and shelled when we are ready to eat them.

For those who do not care for eggs we cut sandwiches of sliced tongue, ham or cold roast beef. We cut the meat thin and we add salt, mustard and a few lettuce leaves. Pressing down the sandwiches with the left hand, we take a sharp knife and cut off the crusts from the four sides of the pile. The sandwiches are then done up individually in waxed paper and put in the lunch basket. Have the filling as moist as possible. If we use lettuce we should add mayonnaise or some other kind of dressing. Canned sardines, over which we squeeze lemon juice, are very appetizing; so is cream cheese mixed with mayonnaise and stuffed olives or nuts.

If you wish, you may build a fire and roast frankfurters over it. You will feel repaid for the work of building the fire when you taste the delicious frankfurters, served between the two halves of a roll.

For dessert we may have various kinds of fruits. Bananas, apples, oranges and peaches will be very acceptable. We must be sure, however, that they are not too ripe and we should pack them so that they will not be crushed in the lunch basket. You may also take cake or cookies, being careful not to take the kinds that crumble easily.

We shall want some sort of liquid to wash down our meal. Piping hot coffee in a thermos bottle is relished by most grown-up picnickers. If you prefer a cold drink, milk or lemonade may likewise be carried in a thermos bottle. If ice cream is sold near the place where you have your picnic, you will find it particularly welcome after a hearty lunch.

It is not a bad plan for the different persons in the picnic party each to contribute provisions for the lunch, thus sharing expenses and dividing the burden. One may bring sandwiches, another fruit, a third cookies and so on. It would be well in this case to come to a clear understanding about the contributions of each member of the party, so that the provisions will not run short.

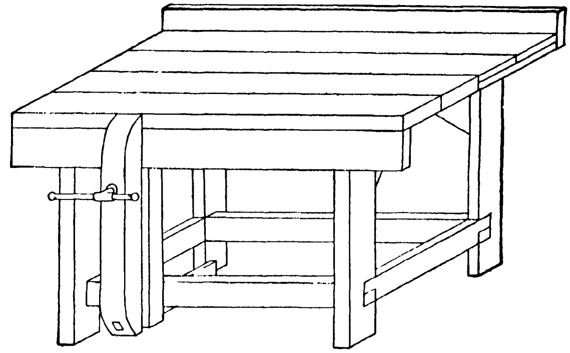
THE GREEK ALPHABET

THE alphabet of the Greeks is still widely used in science, in designating fraternities and for other purposes. The following table gives the various Greek letters, the pronunciation of each and finally the nearest English equivalent.

CAPITAL	SMALL	NAME	ENGLISH
Α	α	Alpha	a
Β	β	Beta	b
Γ	γ	Gamma	g
Δ	δ	Delta	d
Ε	ϵ	Epsilon	ĕ
Ζ	ζ	Zeta	z
Η	η	Eta	ē
Θ	θ	Theta	th
Ι	ι	Iota	i
Κ	κ	Kappa	k
Λ	λ	Lambda	l
Μ	μ	Mu	m

CAPITAL	SMALL	NAME	ENGLISH
Ν	ν	Nu	n
Ξ	ξ	Xi	x
Ο	ο	Omicron	ŏ
Π	π	Pi	p
Ρ	ρ	Rho	r
Σ	σ, ς	Sigma	s
Τ	τ	Tau	t
Υ	υ	Upsilon	u, y
Φ	φ	Phi	ph
Χ	χ	Chi	ch
Ψ	ψ	Psi	ps
Ω	ω	Omega	ō

HOW TO MAKE A USEFUL WORKBENCH



1. A workbench easily made for home use.

HOW would you like to make a workbench for home use? This useful workbench may be made by any boy who is able to use simple woodworking tools and who can secure the necessary lumber. The construction of the bench shown in picture 1 will require pine lumber as follows: 26 feet of 2″ x 4″, 12 feet of 2″ x 6″ and 23 feet of 1″ x 6″. Although dry pine lumber is suggested, this bench may be made from any similar wood that is easily worked.

The boards come in regular lengths, usually from 10 feet up to 16 or 18 feet. In addition to this lumber needed for the bench, a piece of oak or other hard wood 3″ x 4″ about 34 inches long is required for the bench vise. A screw and handle for the vise may be bought at any hardware store; there you may also buy 1 pound of 4-inch nails and 2 square-headed iron bolts, each of which is ½ inch in diameter and 4 inches long. These should be fitted with iron washers and square nuts.

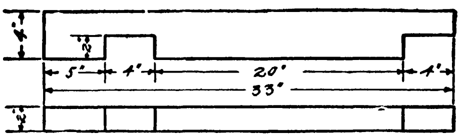
First saw from the 2″ x 4″ lumber four pieces about 33 inches long. These are the legs of the bench, and they are made to stand with their broader faces toward the ends of the bench. Then cut joints in each one of these legs as shown in picture 2. The sides in which the joints are cut must face each other at the ends of the bench. Into these joints is fitted the supporting framework, as may be seen in picture 1. The lower framework is also cut from the 2″ x 4″ lumber. Two pieces 42 inches long and four pieces 19 inches long are needed. Two of the 19-inch pieces should be left plain, while the other two of this size and the two 42-inch pieces should have joints 2 inches by 2 inches, cut on both ends from the same edge (see joints on right end of picture 1). These joints, as well as the joints in the legs, are easily cut with a saw, and the wood is quickly split out with a chisel. Next, these four jointed pieces are either fitted together with screws or are glued and nailed to form the framework. The four legs are fitted in place and fastened with screws or nails. Then the other two 19-inch pieces are fitted into the top of the uprights across each end and fastened in place.

Four braces for the ends are made from two 16-inch pieces of the 1″ x 6″ stock by resawing these and cutting off the corners 1½ inches in either direction. Each piece is first sawed in two, lengthwise, with a ripsaw. This will give four pieces 16 inches long and 3 inches wide. Then mark the centre joint of each end of each piece. Now measure on both sides, from each end, a distance of 1½ inches. Connect these points with the end points by a line and saw off the corners, leaving on each end a right-angled point. The braces are then fastened in place. This finishes the body part of the bench. Next, cut from the 1″ x 6″ lumber a piece 56 inches long. This is fitted across the front of the frame, just even with the top, and made to project just 7 inches beyond the legs at either end. Then fasten by nailing in position.

For the top of the bench cut from the 2″ x 6″ lumber two pieces 56 inches long. One of these is then placed across the top of the bench at the extreme front, so that it comes even with the wide surface of the front board. This is nailed to the end framework, and the second piece is fastened in position directly back of it. This part of the top is made heavier, for it is near the front, where the main strain of the work will be had. The remainder, or back part, of the top is made of two strips of 1″ x 6″ wood. In order to make this even with the two front strips, which are thicker, it is necessary to put a piece underneath it at each end. Make these two pieces by cutting one piece of 1″ x 6″ board 12 inches long and ripping it in two. First place these strips along the end frame. Put the top boards on them before nailing all of these in place. When this is done the top of the bench may be planed smooth. Then cut another strip of 1″ x 6″ lumber 56 inches long and nail it across the back of the bench, allowing it to project about 3 inches above the top, as shown in the drawing.

The vise as it comes from the hardware store usually consists of a long straight

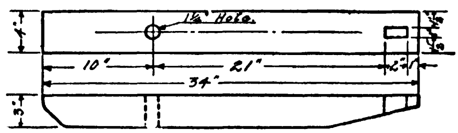
square-headed screw about 1 inch in diameter. It ends in a round iron plate and a T-shaped pipe. The plate is loose, but not removable. Through the T a long wooden handle is fitted. In addition to this there is an elliptical plate holding a threaded pipe in which the screw works. To put it together, first make a piece from the remaining 2" x 6" lumber 6 inches wide and 32 inches long.



2. Working drawing of bench-leg.

This piece forms the inner side of the vise and fits just inside the front piece of the bench. From one end of the piece a slot 1¼ inches wide and 4⅛ inches long is cut in the middle of the 6-inch face to form the bottom. It touches the under-side of the top, and is placed outside of the lower framework. Its edge should be located 4 inches in from the front leg of the bench. Corresponding holes are made with a bit and brace in this piece and in the front piece of the bench. These are countersunk ½ inch in the front piece through the use of a brace and a special sharp steel bit made for just such a purpose, and the two pieces are then bolted together. The heads of the bolts and the iron washer fit into the countersunk holes, and the other washer is placed under the nut on the other side. The vise screw is fastened in position through a 1½-inch hole which is bored in the back of the piece that forms the inner side of the vise.

Now you are ready to make this piece of oak into a convenient vise jaw. The piece is first shaped at the ends as shown in picture 3. The outer edges are then rounded. A hole somewhat larger than the vise screw is cut through as shown. Finally a mortise joint is cut through with a chisel and a hammer as shown in the drawing. Into this



3. Working drawing of vise front.

is fitted one end of a piece of 1-inch wood 4 inches wide and 12 inches long. This is used to keep the jaws of the vise even when it is being used. It should be fitted into the oak piece with a drive fit and should have two rows of holes zigzagged across it. Into these a round 3-inch peg is fitted. This is placed in different holes so that the bottom opening of the vise may be adjusted to become parallel with the top opening needed to hold the work. To complete the bench the long screw of the vise is now slipped through the hole which has been made for it, and the plate is screwed in place.

If you follow these directions you will have a workbench which will prove highly satisfactory for general home use. Later you will doubtless wish to make convenient devices and accessories to be used with this sturdy and useful workbench.

THE GAME OF EGG HAT

THIS is a game to be played with a soft rubber ball. Five to ten boys may take part in the game; each must have a cap.

The caps of the players are laid in a row on the ground at the foot of a wall; they should be tilted a little, so as to make it easier to toss a ball into them. The players stand in a row, forming a line about eight steps away from the caps. One of them tries to toss the ball into one of the caps. The moment the throw is made, all the players scatter except the boy into whose hat the rubber ball has been tossed. This boy must take out the rubber ball as quickly as possible and throw it at one of the other players. If it hits him, this boy in turn must toss the ball at the hats.

If the thrower misses the boy at whom he aimed, a small pebble is placed in his cap as a bad mark. If the boy who tosses the ball at the caps misses the mark, a small pebble is placed in his cap.

When any player has missed so often that the number of pebbles in his cap equals the number of players, he must stand at a short distance while the rest throw the ball at him, each in turn. The game then starts anew.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 4079.

WILD FRUITS OF THE COUNTRYSIDE

HAVE you ever tried to collect and name some of the beautiful wild berries or fruits that you pass in your autumn rambles among the hills and woods? The birds depend upon them for food and time their flights to follow their harvests. They well repay our interest by giving us gay material for decorating our rooms. Sprays of Bittersweet make a lovely touch of color when all the flowers are gone. Pine Cones last a long while and, finally, when their use for adornment is passed, make a cheery blaze in the fireplace. Set your Partridge Berry in a covered glass bowl with a little moisture and it will gaily gleam and draw many an admiring friend to gaze upon its glossy foliage and fruit.

Not all the fruits we show you in the following pages can be found in America, although most of them can. Many of them are immigrants from Europe. Some come in as ballast, some are brought by birds, some arrive sticking to the boots of countrymen. They have a hundred ingenious ways of working their passage round the world!

The Cloudberry is really a species of dwarf raspberry which grows from four to eight inches high in the highlands of Great Britain, in the arctic and sub-arctic regions, and in some localities in Canada and New England. The flowers are large and white. Everybody knows the Crabapple, with its bright red fruit which has such a bitter taste. Originally probably a native of Central Asia, the apple is cultivated now in all temperate regions, in many varieties. It was introduced into America from England by a governor of the Massachusetts Bay Colony, and into Canada by the French settlers from Normandy and Brittany.

The Sweet Briar, or Eglantine, native of Asia and Europe, has been brought into eastern America. It is a tall-stemmed rose, well armed with prickles. It gets its name from the delicious perfume of its leaves. The black berries of the Privet succeed its spike of white, heavily perfumed flowers. Common in the old world, the privet is planted, and to some extent naturalized, in America. The Strawberry tree is a southern European plant. Its fruit is quite beautiful and agreeable to the taste, and in Spain a popular beverage is made from it. The queer clustered head of the English Spurge-laurel does not belong to the true laurel.

All of us know the Acorn, the fruit of the oak. In some periods of civilization acorns have been used for food, and indeed are still so used in some countries. We recognize the Barberry by its hanging bunches of yellow flowers which have such a disagreeable odor. The berries are elongated in shape and pleasantly acid in flavor. Although native to Europe, the plant has been naturalized in New England and Canada. We can eat the greenish black berries of the Whortle, a low bush with numerous angled branches. Common in Europe and Siberia, it grows in America from Colorado to Alaska.

BERRIES THE INDIANS CALLED "KINNIKINNICK"

Western Indians used to smoke a mixture of leaves and bark that they called *kinnikinnick*. They also gave this name to the bearberry, used in the mixture, a trailing evergreen shrub with astringent bitter leaves and bright red drupes. The winged seeds of the sycamore maple are queer things that make us almost think of them as vegetable airplanes! In America this maple is not common, although it has been naturalized in eastern United States. The fruit of the small cranberry shown in color is not the cranberry that is cultivated and gathered for the market, although it grows on similar sites. These are flooded areas, usually called cranberry bogs.

In Europe the larch is native in the Alps. In England and the United States it is cultivated for its symmetrical shape and durable wood.

There are several species of wild gooseberry in North America, but their fruit is rarely eaten, and the cultivated fruit does much better in northern Europe and Asia. Following the beautiful panoply of white that the dogwood spreads for us in springtime come its clustered berries in the fall as the leaves are beginning to turn warm crimson in the clear cold November days.

CRUNCHY HAZELNUTS, LUSCIOUS DEWBERRIES AND SAVORY WILD CAPERS

The hazelnut will reward our search and our appetites if we wait till the hot August sun has done its part toward hardening the shell and ripening the kernel. So, too, with the luscious dewberry, with its large sweet fruit. A plant with good flavoring properties is the caper spurge, or wild caper, whose immature capsules are used sometimes as a substitute for real capers.

Though not so juicy and well flavored as the cultivated variety, the wild raspberry is a very refreshing and abundant fruit. Beloved of all the birds is the wild cherry, first herald of spring, displaying its dainty pearly white blossoms and pale green leaves. The wild currant, both black and red, will make good jam if enough of its fruit escapes the eager bills of its bird visitors. The wild strawberry is ours for the search, and the beechnut, too. The hawthorn has been introduced into America, but it is not so widespread as it is in Great Britain.

Open the bright red skins of the fruit of the field rose and you will find a number of seeds. Birds devour this covering and liberate the down-fringed seeds. To the plentiful flat white heads of the elder blossom succeed the luxuriant spikes of black berries, used by country people in many a good cordial and in jam. Jack-in-the-pulpit lays aside his purple spathe and arms himself with knobby scarlet fruits in the autumn. If we are in the North we shall see the crowberry, and perhaps the wild pear, though the latter will disappoint us in the woody texture of its fruit and total lack of flavor.

A RARE SIGHT—THE EUROPEAN POPPY

The lantern-like shape of the European poppy seed-head, with its millions of little black seeds, we shall seldom find, for authorities in this country have set their faces sternly against this tare among the wheat. Snowberries are native northward in North America. The Oriental plane tree has more than one ball of fruit dangling from the stem. This tree, introduced into America, has become familiar as a shade tree.

The bilberry belongs to the family Vacciniaceae. Its leaves are small and evergreen, the flowers white, pink and red. One of the viburnums—the snowball, or guelder-rose—is most ornamental in spring, with its fluffy white balls of bloom. The common holly shown you in the color picture is the European, which has glossier foliage and brighter berries than the American variety to be found south of Massachusetts and west to the Colorado River. The bogbean, or buckbean, belongs to the gentian family and is to be found in swamps. It is a relative of the lovely blue fringed gentian.

THE THORN APPLE, WHICH WELL DESERVES ITS NAME

It is easy to see the reason for the term thorn apple, as applied to the fruit of one of the *Datura*. The black solanum, or nightshade, might be called cosmopolitan, so widespread is its distribution. The American turkey oak grows chiefly in southeastern United States and is valuable for fuel.

The white berries of the mistletoe belong to our Christmas gaieties. The plant is a parasite. Common in Europe, the American genus grows only in the South. The wild black cherry of the United States is much visited by birds, and its light, strong and reddish wood is largely used for cabinet-work and finishing. We may find both the American and the European mountain ash in our walks.

THE NEXT STORY ON PLANT LIFE IS ON PAGE 4093.

WILD FRUITS OF THE COUNTRYSIDE

1. Cloudberry. 2. Crab Apple. 3. Sweetbriar Fruit. 4. Privet Fruit. 5. Strawberry-tree Fruit (E.). 6. Spurge Laurel (E.). 7. Acorns. 8. Common Barberry. 9. Whortleberry. 10. Butcher's Broom (E.).
Plants marked (E.) are European and are not generally found in America.

1. Common Bearberry. 2. Maple. 3. Cranberry. 4. Larch. 5. Mezereon (E.). 6. Hops. 7. Gooseberry. 8. Dogwood. 9. Fetid Iris (E.).

1. Hazel. 2. Dewberry. 3. Caper Spurge. 4. Yew (E.). 5. Sea Buckthorn. 6. Wayfaring Tree (E.). 7. Red Raspberry. 8. Bullace (E.). 9. Wild Red Cherry. 10. Wild Black Currant.

1. Honeysuckle (E.). 2. Laurel (E.). 3. Strawberry. 4. Beechnuts. 5. Medlar (E.). 6. Common Buckthorn. 7. Hawthorn. 8. Tutsan (E.). 9. Fly Honeysuckle (E.).

1. Field Rose. 2. Elder. 3. Jack-in-the-Pulpit. 4. White Bryony (E.) 5. Sweet Chestnut (E.). 6. Crowberry. 7. Alder Buckthorn (E.). 8. Wild Pear. 9. Red Currant.

1. Common Red Poppy (E.). 2. Snowberry. 3. Plane Tree. 4. Bilberry. 5. Guelder Rose. 6. Common European Ivy. 7. Black Bryony (E.). 8. Common Holly (E.). 9. English Walnut. 10. Bog-bean.

1. Broom (E.). 2. Mistletoe. 3. Wild Cherry. 4. Wild Service Tree (E.). 5. Mountain Ash, or Rowan. 6. Blackthorn, or Sloe (E.). 7. Dog Rose. 8. Horse-chestnut. 9. Common Ash.

1. Blackberry. 2. Scotch Pine. 3. Roebuck-berry, or Stone Bramble (E.). 4. Common Spindle Tree 5. Thorn Apple. 6. Bitter-sweet. 7. Common English Elm. 8. Black Solanum, or Nightshade 9. Turkey, or Moss-cupped Oak (E.). 10. Deadly Nightshade, or Dwale (E.).

STORY POEMS—HUMOROUS

Drawings by Alajálov

The Yarn of the Nancy Bell

By William S. Gilbert (1836-1911)

'Twas on the shores that round our coast
From Deal to Ramsgate span,
That I found alone, on a piece of stone,
An elderly naval man.

His hair was weedy, his beard was long,
And weedy and long was he;
And I heard this wight on the shore recite,
In a singular minor key:

"Oh, I am a cook and a captain bold,
And the mate of the *Nancy* brig,
And a bo'sun tight, and a midshipmite,
And the crew of the captain's gig."

And he shook his fists and he tore his hair,
Till I really felt afraid,
For I couldn't help thinking the man had been drinking,
And so I simply said:

"Oh, elderly man, it's little I know
Of the duties of men of the sea,
And I'll eat my hand if I understand
However you can be

"At once a cook, and a captain bold,
And the mate of the *Nancy* brig,
And a bo'sun tight, and a midshipmite,
And the crew of the captain's gig."

Then he gave a hitch to his trousers, which
Is a trick all seamen larn,
And having got rid of a thumping quid,
He spun this painful yarn:

" 'Twas in the good ship *Nancy Bell*
That we sailed to the Indian Sea,
And there on a reef we come to grief,
Which has often occurred to me.

"And pretty nigh all o' the crew was drowned
(There was twenty-seven o' soul),
And only ten of the *Nancy's* men
Said 'Here!' to the muster-roll.

"There was me, and the cook, and the captain bold,
And the mate of the *Nancy* brig,
And the bo'sun tight, and a midshipmite,
And the crew of the captain's gig.

"For a month we'd neither wittles nor drink,
Till a-hungry we did feel,
So we drawed a lot, and, accordin', shot
The captain for our meal.

"The next lot fell to the *Nancy's* mate,
And a delicate dish he made;
Then our appetite with the midshipmite
We seven survivors stayed.

"And then we murdered the bo'sun tight,
And he much resembled pig;
Then we wittled free, did the cook and me,
On the crew of the captain's gig.

"Then only the cook and me was left,
And the delicate question, 'Which
Of us two goes to the kettle?' arose,
And we argued it out as sich.

"For I loved that cook like a brother, I did,
And the cook he worshipped me;
But we'd both be blowed if we'd either be stowed
In the other chap's hold, you see.

" 'I'll be eat if you dines off me,' says Tom.
'Yes, that,' says I, 'you'll be,—
I'm boiled if I die, my friend,' quoth I;
And, 'Exactly so,' quoth he.

"Says he: 'Dear James, to murder me
Were a foolish thing to do,
For don't you see that you can't cook *me*,
While I can—and will—cook *you!*'

"So he boils the water, and takes the salt
And the pepper in portions true
(Which he never forgot), and some chopped shalot,
And some sage and parsley too.

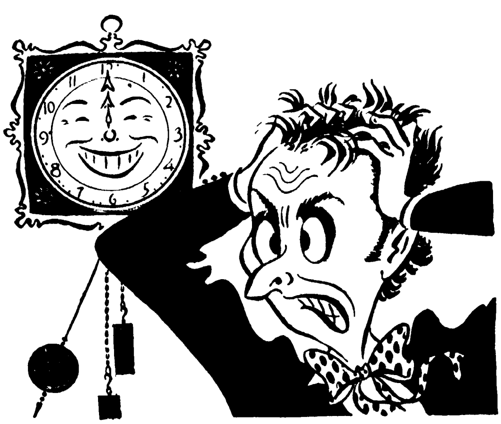
" 'Come here,' says he, with a proper pride,
Which his smiling features tell,
' 'Twill soothing be if I let you see
How extremely nice you'll smell.'

"And he stirred it round and round and round,
And he sniffed at the foaming froth;
When I ups with his heels, and smothers his squeals
In the scum of the boiling broth.

"And I eat that cook in a week or less,
And—as I eating be
The last of his chops, why, I almost drops,
For a wessel in sight I see.

"And I never larf, and I never smile,
And I never lark nor play;
But sit and croak, and a single joke
I have—which is to say:

"Oh, I am a cook and a captain bold
And the mate of the *Nancy* brig,
And a bo'sun tight, and a midshipmite,
And the crew of the captain's gig!"



The Sad Tale of Mr. Mears

THERE was a man who had a clock,
His name was Matthew Mears;
And every day he wound that clock
For eight and twenty years.

And then one day he found that clock
An eight-day clock to be,
And a madder man than Matthew Mears
You would not wish to see.

The Ballad of the Oysterman

By OLIVER WENDELL HOLMES (1809-1894)

IT was a tall young oysterman lived by the riverside,
His shop was just upon the bank, his boat was on the tide;
The daughter of a fisherman, that was so straight and slim,
Lived over on the other bank, right opposite to him.

It was the pensive oysterman that saw a lovely maid,
Upon a moonlight evening, a-sitting in the shade;
He saw her wave a handkerchief, as much as if to say,
"I'm wide awake, young oysterman, and all the folks away."

Then up arose the oysterman, and to himself said he,
"I guess I'll leave the skiff at home, for fear that folks should see;
I read it in the story-book, that, for to kiss his dear,
Leander swam the Hellespont,—and I will swim this here."

And he has leaped into the waves, and crossed the shining stream,
And he has clambered up the bank, all in the moonlight gleam;
Oh, there are kisses sweet as dew, and words as soft as rain—
But they have heard her father's step, and in he leaps again!

Out spoke the ancient fisherman: "Oh, what was that, my daughter?"
" 'Twas nothing but a pebble, sir, I threw into the water."
"And what is that, pray tell me, love, that paddles off so fast?"
"It's nothing but a porpoise, sir, that's been a-swimming past."

Out spoke the ancient fisherman: "Now bring me my harpoon!
I'll get into my fishing-boat, and fix the fellow soon."
Down fell that pretty innocent, as falls a snow-white lamb;
Her hair drooped round her pallid cheeks, like seaweed on a clam.

Alas for those two loving ones! she waked not from her swound,

And he was taken with the cramp, and in the
waves was drowned;
But fate has metamorphosed them, in pity of
their woe,
And now they keep an oyster-shop for
mermaids down below.

My Room*

I WISH that my room had a Floor;
I don't so much care for a Door,
But this walking around
Without touching the ground
Is getting to be quite a bore!

By GELETT BURGESS

THERE was a young man so benighted
He didn't know when he was slighted,
But went to the party
And ate just as hearty
As if he'd been really invited!

THERE was a young lady of Niger
Who smiled as she rode on a tiger;
They returned from the ride
With the lady inside,
And the smile on the face of the tiger.

*From The Burgess Nonsense Book, by Gelett Burgess; published by Frederick A. Stokes Company, New York.

The Deacon's Masterpiece, or the Wonderful One-Hoss Shay

By OLIVER WENDELL HOLMES (1809-1894)

HAVE you heard of the wonderful one-hoss
shay,
That was built in such a logical way
It ran a hundred years to a day,
And then, of a sudden, it—ah, but stay,
I'll tell you what happened without delay,
Scaring the parson into fits,
Frightening people out of their wits,—
Have you ever heard of that, I say?

Seventeen hundred and fifty-five.
Georgius Secundus was then alive,—
Snuffy old drone from the German hive.
That was the year when Lisbon-town
Saw the earth open and gulp her down,
And Braddock's army was done so brown,
Left without a scalp to its crown.
It was on the terrible Earthquake-day
That the Deacon finished the one-hoss shay.

Now in building of chaises, I tell you what,
There is always *somewhere* a weakest spot,—
In hub, tire, felloe, in spring or thill,
In panel, or crossbar, or floor, or sill,
In screw, bolt, thoroughbrace,—lurking still,
Find it somewhere you must and will,—
Above or below, or within or without,—
And that's the reason, beyond a doubt,
That a chaise *breaks down,* but doesn't
wear out.

But the Deacon swore (as Deacons do,
With an "I dew vum," or an "I tell *yeou,*")
He would build one shay to beat the taown
'N' the keounty 'n' all the kentry raoun';
It should be so built that it *couldn't* break
daown:
"Fur," said the Deacon, " 't's mighty plain
Thut the weakes' place mus' stan' the strain;
'N' the way t' fix it, uz I maintain,
Is only jest
T' make that place uz strong uz the rest."

So the Deacon inquired of the village folk
Where he could find the strongest oak,
That couldn't be split nor bent nor broke,—
That was for spokes and floor and sills;
He sent for lancewood to make the thills;
The crossbars were ash, from the straightest
trees,
The panels of white-wood, that cuts like
cheese,
But lasts like iron for things like these;

The hubs of logs from the "Settler's ellum,"
Last of its timber,—they couldn't sell 'em,
Never an axe had seen their chips,
And the wedges flew from between their lips,
Their blunt ends frizzled like celery-tips;
Step and prop-iron, bolt and screw,
Spring, tire, axle, and linchpin too,
Steel of the finest, bright and blue;
Thorough-brace bison-skin, thick and wide;
Boot, top, dasher, from tough old hide
Found in the pit when the tanner died.
That was the way he "put her through."
"There!" said the Deacon, "naow she'll dew!"

Do! I tell you, I rather guess
She was a wonder, and nothing less!
Colts grew horses, beards turned gray,
Deacon and deaconess dropped away,
Children and grandchildren—where were they?
But there stood the stout old one-hoss shay
As fresh as on Lisbon-earthquake-day!

EIGHTEEN HUNDRED;—it came and found
The Deacon's masterpiece strong and sound.
Eighteen hundred increased by ten;
"Hahnsum kerridge" they called it then.
Eighteen hundred and twenty came;—
Running as usual; much the same.
Thirty and Forty at last arrive,
And then come Fifty, and FIFTY-FIVE.

Little of all we value here
Wakes on the morn of its hundredth year
Without both feeling and looking queer.
In fact there's nothing that keeps its youth,
So far as I know, but a tree and truth.
(This is a moral that runs at large;
Take it.—You're welcome.—No extra charge.)

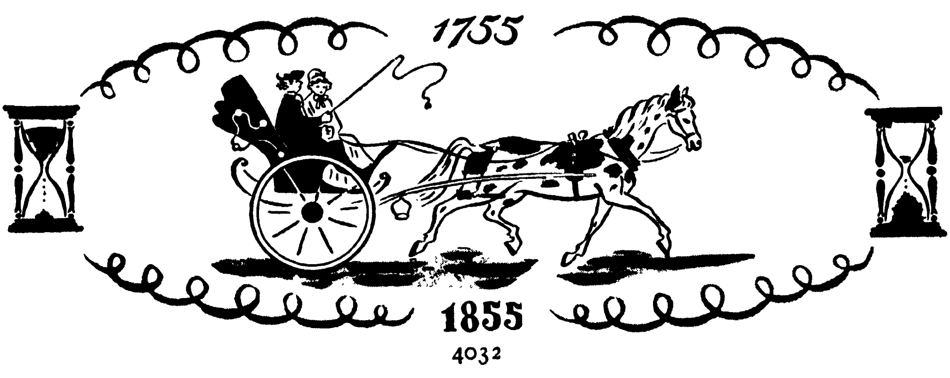
FIRST OF NOVEMBER,—the Earthquake-day,—
There are traces of age in the one-hoss shay.
A general flavor of mild decay,
But nothing local, as one may say.
There couldn't be,—for the Deacon's art
Had made it so like in every part
That there wasn't a chance for one to start.
For the wheels were just as strong as the thills,
And the floor was just as strong as the sills,
And the panels just as strong as the floor,
And the whipple-tree neither less nor more,
And the back-crossbar as strong as the fore,
And spring and axle and hub *encore.*
And yet, *as a whole,* it is past a doubt
In another hour it will be *worn out!*

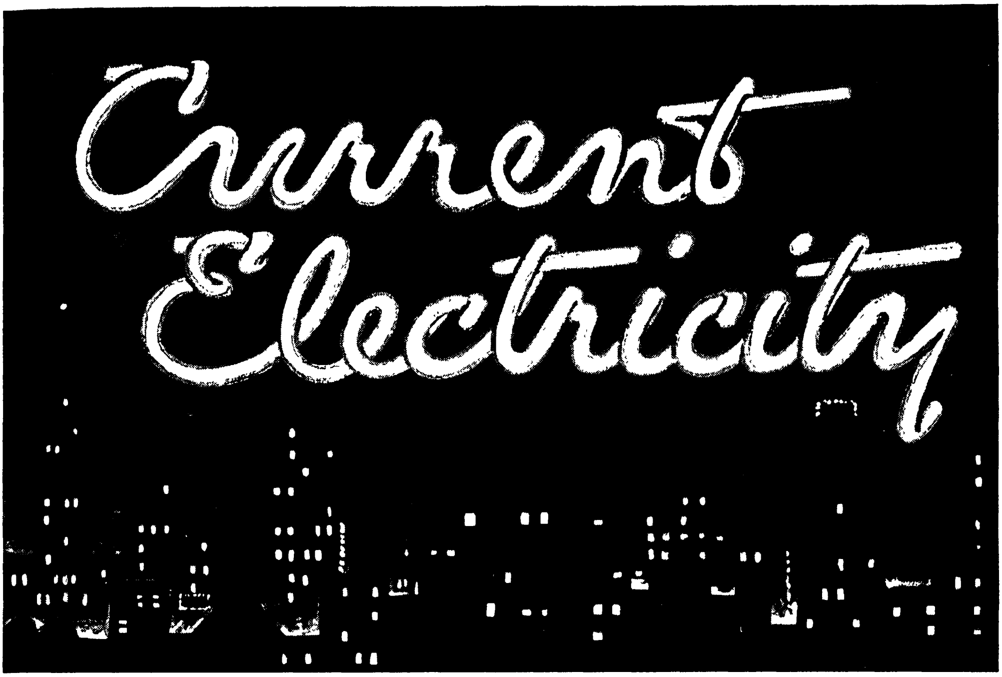
First of November, Fifty-five!
This morning the parson takes a drive.
Now, small boys, get out of the way!
Here comes the wonderful one-hoss shay,
Drawn by a rat-tailed, ewe-necked bay.
"Huddup!" said the parson.—Off went they.

The parson was working his Sunday's text,—
Had got to *fifthly,* and stopped perplexed
At what the—Moses—was coming next.
All at once the horse stood still,
Close by the meet'n'-house on the hill.
First a shiver, and then a thrill,
Then something decidedly like a spill—
And the parson was sitting upon a rock,
At half past nine by the meet'n'-house clock,—
Just the hour of the Earthquake shock!
What do you think the parson found,
When he got up and stared around?
The poor old chaise in a heap or mound,
As if it had been to the mill and ground!
You see, of course, if you're not a dunce,
How it went to pieces all at once,—
All at once, and nothing first,—
Just as bubbles do when they burst.

End of the wonderful one-hoss shay.
Logic is logic. That's all I say.

THE NEXT POEMS ARE ON PAGE 4048.





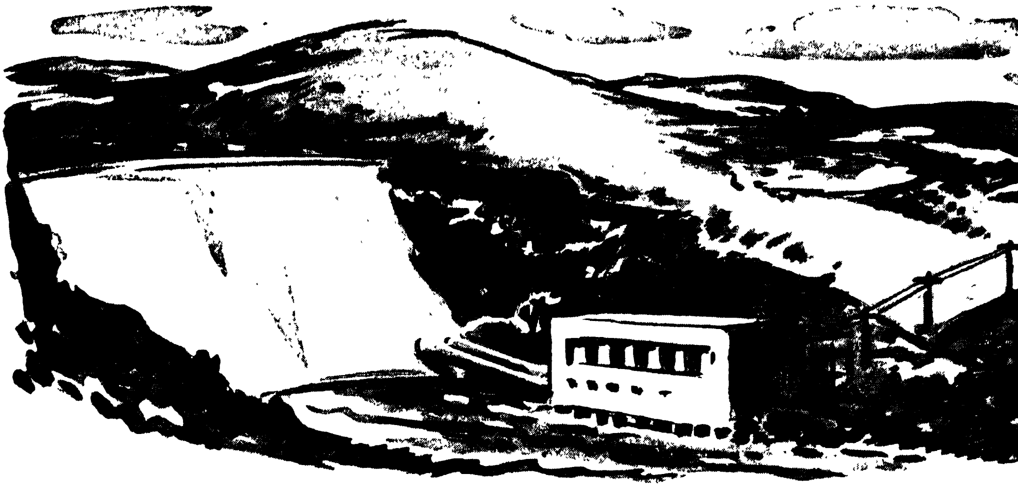
THE STREAMS OF TINY ELECTRONS WHICH LIGHT YOUR LAMPS

IN another story (on page 3687) you have learned some general facts about electricity. Let us now find out more about electric current, which started with a chance discovery by the Italian, Galvani, about 150 years ago, and has since grown into a most powerful servant for all men.

There are many ways to make an electric current flow—for instance, by connecting a wire from one of the two poles (or terminals) of a battery to the other pole. If you do that, the battery (or "cell") forces millions of tiny electrons to flow continuously in a complete path, or "circuit," out at the pole marked *negative,* through the outside wire, into the *positive* pole, back through the inside of the cell, out again at the negative pole, and so on. Of course, each electron is very tiny (it would take several billion billion billions of them to weigh as much as one penny), but in the flow through the circuit they come in great numbers.

Now the usual practical measure of electric current is the *ampere.* Any flashlight battery can make one ampere flow through a wire—that means that about six billion billion electrons flow past any point in the wire in one second. This way of measuring electric currents is quite similar to saying of a river: "The water current of this river is so many billion water drops flowing under a bridge during every second." In fact, the similarity between the flow of water and of an electric current is very helpful, and we shall use it often.

It is easy enough to get briefly a flow of electrons, for instance, from an electrically charged piece of metal to the ground—just as water will flow for a little while when we upset a glassful. But to get a *continuous* electric current we have to fulfill two important conditions: one is a *well-conducting, continuous path* in which the electrons can go around and around. A thick wire across the battery, together with the well-conducting *inside* of the battery, makes such a continuous path. You can compare this with the case of water, when it flows down through a pipe (which resembles the wire) and is pumped back up again by a pump (which acts like the battery). Naturally a continuous flow of water is impossible if the pipe



The power of rushing water is often used to turn huge generators. They, in turn, supply electricity to

does not provide a continuous path from one end to the other. Break off a section of the pipe, and the water will not flow all around the circuit; in the same way the continuous flow of electric current stops when the wire is cut.

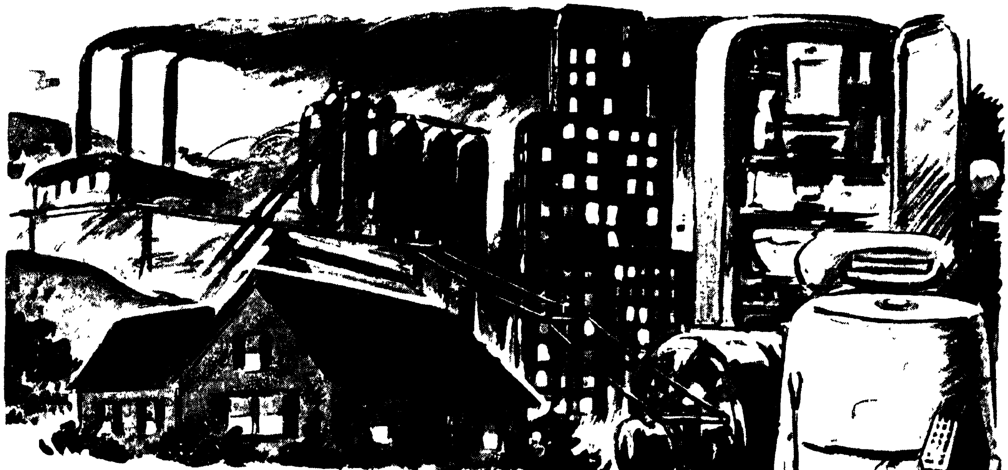
The second important condition for the flow of a continuous electric current is that there be in the circuit somewhere a battery or generator or similar device which produces the *internal,* electric force necessary to push the electrons out into the wire at one pole and pull them back again through the inside after they reach the other pole. This means work has to be done on the electrons, just as the pump does work on the water. In the battery this is accomplished by chemical action at the expense of materials which are eaten away, that is, corroded. The generator produces the energy necessary to do this work by electromagnetic forces which, in turn, are furnished through the action of big steam turbines or waterfalls or gasoline motors.

You see now that energy is expended on the electrons to make them flow in the closed path or circuit. In the case of water some of this energy is used up in friction along the walls of the pipe. Electrons, too, lose energy by a kind of friction in the wire. The friction heats up the wire—and we make use of the heat in electric toasters, heaters and irons. If a wire is heated very much it may begin to glow and emit strong light, as in our electric lamps.

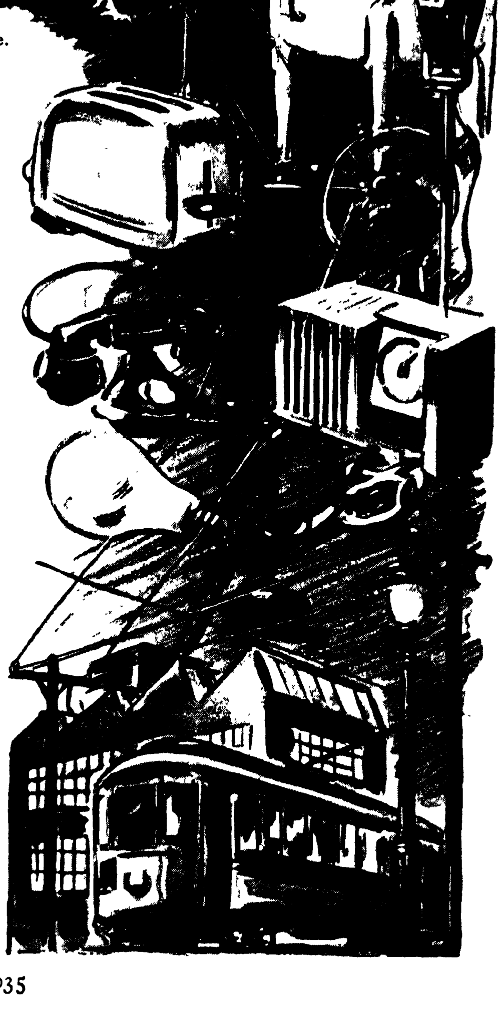
The energy of the electrons need not be used up in friction alone. A flow of water can turn water-wheels, and similarly a stream of electrons, besides providing heat and light, can be made to do useful work in many other ways.

Before we look at those interesting effects of electric currents, we have to stop a moment to hear about an error which was made by the experimenters very soon after the discovery of electricity. We have seen that the flow of electrons, which constitutes the current, goes out into the wire from the negative pole of the battery, and flows back through the positive pole. In the early days, when actually there was no way to find out differently, the scientists guessed that the current flows through the wire from the positive (+) to the negative (—) pole; that is, opposite to the actual way. And, perhaps for sentimental reasons, some people still talk of currents flowing from (+) to (—), though we know now that this does not agree with the behavior of the electrons. We shall speak of the current as flowing from (—) to (+).

You have now a picture of the electric current; but there is one danger in taking our analogy with a flow of water too seriously. The metal wire which we used to complete the circuit for the electrons to flow in is actually quite full of freely moving electrons to start with. Even before we connect it to the battery it is not "empty" like an unconnected, hollow water pipe. Actually it is mostly these electrons which are pushed and moved by the battery or generator; and they do not really race around the path, but rather



operate all these familiar objects of our everyday life.

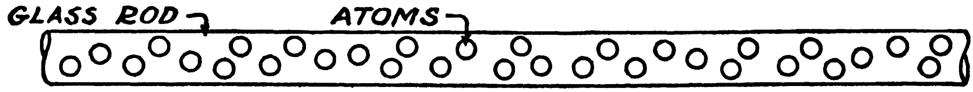


drift between the atoms of the wire like thick clouds through the tree tops, high up in the mountains. If such an electron cloud were not present in the wire before connecting it we could never get conduction of current—the material would be a "non-conductor."

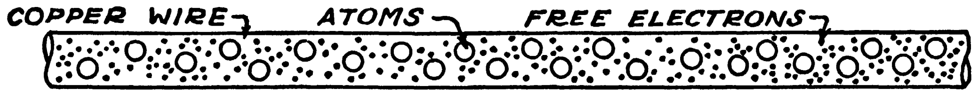
If we use a generator as source of power in the circuit, we can arrange it so that the electrons drift alternately back and forth, as in the ordinary *alternating current* used in most households. In such a system the electrons will change direction every 1/120 second; that is, the electrons fluctuate back and forth sixty times in each second, or "with a frequency of 60 cycles per second."

All batteries, however, produce a *steady* current in an unchanging direction—we call this a *direct current*. There are two different kinds of batteries. One is the group of primary cells. The ordinary dry cell in your flashlight belongs to this group. Most primary cells are useful when only a rather small current is required. They can not be re-charged. They have to be thrown away when they are run down, since they depend for their life on the chemical corrosion of one of the two poles, or *electrodes,* and the decomposition of the *electrolyte,* the liquid or moist paste in which the electrodes are immersed. This destructive action inside the cell stops when the materials are used up.

The other kind of battery, the storage cells, can be re-charged when they have run down. That is the kind used in motor cars to supply the automatic starter, lights and so on with current. Here one electrode is made of pure



A glass rod is a non-conductor, or insulator, because it offers great resistance to the flow of free electrons.



A copper rod will conduct electricity well, because the copper atoms do not hold back the flow of free electrons.

lead, the other of a lead compound, and both are immersed in diluted sulfuric acid. The chemical action between acid and poles makes the first pole negative and the second one positive. In time the electrodes and the electrolyte become more and more changed chemically, till the action stops. Then the battery has "run down"; but it can be converted to the original state rather easily by passing current (say from a direct-current generator) through the battery in the *opposite* direction to the one that was delivered from it. Do not imagine that we thus pump the battery full of electrons for later use! In recharging we just reverse the chemical action inside the cell, so that the materials in the cell go back toward their original state.

Apart from the advantage of not having to throw them away when they are run down, these storage batteries also are much more capable of delivering big currents than are the primary cells. This is because storage cells can be built so as to offer only very little internal resistance to the flow of electrons through the inside of the battery; whereas the higher internal resistance of primary cells limits the current that can flow in them to small quantities.

This important point, too, is illustrated in the case of our water-pump system. If the inside of the pump is small, and full of obstacles for the water, the flow will not ever be very large, even if the pressure from outside is great.

SOME LAWS OF ELECTRICITY

The flow of water would also be much reduced if the external pipes have a small connection, or are not smooth on the inside walls, or are very long. The wire used for conducting electricity also will cut down the current if it is very thin and long and made of a material which, by a kind of friction, impedes the free flow of electrons. Thus, even if two wires of *different materials* have the same shape, they will offer *different resistances* to the flow of currents. Copper has a small resistance, iron conducts less well, and glass rods, for instance, are non-conductors altogether. These nonconductors are known as insulators.

This resistance of various wires is measured in a unit called the *ohm.* A hundred feet of copper wire of the size ordinarily used for electric current has a resistance of about one ohm. An iron wire of the same shape would have about ten ohms.

But even for a given wire—made, say, of copper—the resistance changes when the wire is heated! For copper and most other materials there is an increase of resistance as the temperature rises; but the resistance of those thin carbon filaments you may still see in very old lamps goes down when the wire gets hotter.

Now we can discover some other important laws of electricity. Let us take a few feet of thin copper wire which we know to have a certain amount of resistance to the flow of current. We need also a few batteries of different sizes, and some instrument to tell us how much current flows in the wire if connected to a cell. (Since current is measured in amperes, let us call this the amperemeter, or for short, ammeter.)

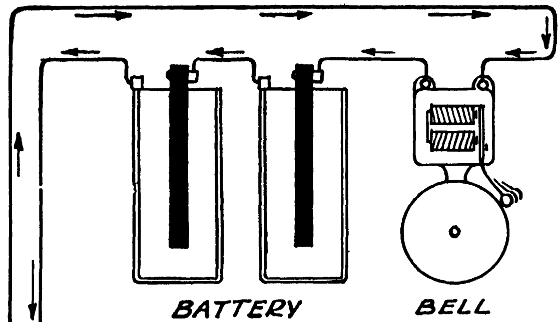
As expected, greater current will flow through the same wire if connected to the more powerful batteries, because they generate in their interior greater forces for pushing the electrons through the circuit. Some part of this internal force—called the *electromotive force*—is used up inside the battery to overcome internal resistance. But most of that force is left over for pushing the electrons through the copper wire. This excess "pressure" that appears between the (+) and (—) terminals is called *potential difference.* (Just as resistance is measured in ohms, and current is measured in amperes, the measure of potential difference is the volt. Hence, potential difference is often

also called voltage.) The larger this potential difference is, the greater is the electron current that can flow through our wire.

This last sentence contains one of the most important laws of electricity, namely, Ohm's Law. This law says that the current that will flow in a wire increases if the potential difference is increased (for instance, by using a bigger battery), and is cut down if the resistance of the conductor is made larger (for instance, by using iron wire instead of copper).

We have already spoken about the usefulness of electricity in giving us light and heat. Sometimes the heat produced by the flow of electrons is so large that the conductor melts. That is put to good use in welding, and in making fuses which will "blow" (melt) and so interrupt the current if it should get too large to be safe.

We have also seen that electricity is sometimes related to chemical effects. If we immerse the two electrodes of a battery in certain kinds of liquids, and so make electric current flow through the liquids, some remarkable things may happen. In water (made more conducting by mixing into it a few drops of an acid) we shall soon see bubbles of gas rising from the electrodes. The passage of current through the water (H_2O) helps to tear apart the hydrogen (H) and oxygen (O) which make up water molecules; and both gases rise separately, one at the negative electrode, the other at the positive one. This process is called *electrolysis,* and it is often used to get pure gases conveniently.

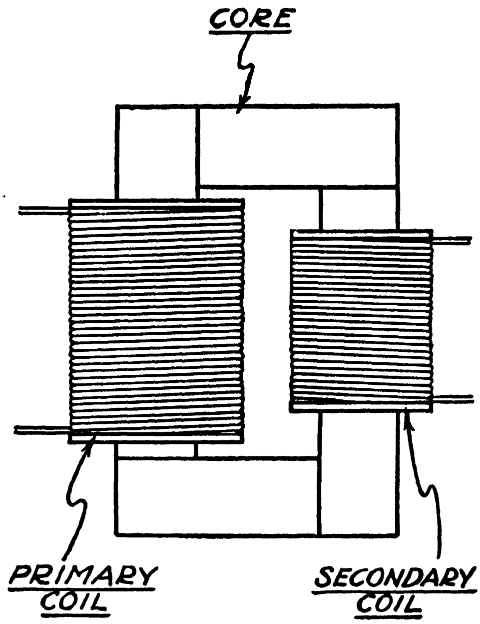


Pushing the button completes the electrical circuit and rings the bell. Electrons flow in a closed path from the battery, through the copper wire, to the bell and back to the battery again. The ringing of the bell is caused by the action of a small electromagnet, which we tell you about in the text.

However, in some liquids the parts of the molecules torn up by the current do not rise as gases, but either combine with other chemicals in the liquid, or settle as a deposit on one of the electrodes, or sink to the bottom of the liquid. The copper that is liberated by sending current through a solution of copper sulfate makes a nice film of copper on the negative electrode. We call this copper-plating.

Let us perform a trick: Take an iron plate, connect one corner to the negative terminal of a battery, and dip the plate and the positive pole into a copper sulfate solution. Now current will flow from the battery through the iron plate, through the liquid, and back to the battery. The copper, which is again liberated from the liquid, now forms a thin layer over the iron plate, and remains on the iron forever, even after we stop the current and take out the plate.

The advantage of this process is that such a copper coating protects the iron from getting rusty. That is often of great importance. And, similarly, by choosing different liquids, we could make a metallic coat of nickel, silver or gold over our iron plate or over a similar conducting object. The chapter on Ions will tell you more about this interesting chemical process.



By changing the current in the primary coil it is possible to produce a current in the secondary coil. This is called a transformer.

Even more useful than these chemical effects of electric currents are the *magnetic* effects. You have read on page 3984 how Oersted of Copenhagen, more than 125 years ago, discovered accidentally that a current flowing steadily through a wire sets up a strange magnetic field around the wire. If that wire is made into a coil, the magnetic effect owing to the current in the coil windings is just like the effect of a little permanent magnet put in place of the coil. And *the stronger the current is, the larger is the magnetic effect.* By this means we can compare and measure the strength of currents. In fact, almost all meters for currents and voltages depend on this principle.

An important use of this effect is made in the *electromagnet.* This is nothing but a coil carrying a steady and usually large current. When the current is passing through, the coil has a large magnetic field, and so it is able to lift heavy pieces of steel or iron. If the hollow space inside the coil is filled with iron, the electromagnet is even more efficient and can be used to hoist loads many times its own weight. A lifted load can be released by cutting off the current.

By alternately and automatically switching the current in a small electromagnet on and off, a piece of iron held by a spring can be attracted and released many times a second. And if this oscillating piece of iron happens to hit a bell every time it snaps back —we have our familiar doorbell.

We come now to the remarkable discovery which was made by Michael Faraday in England more than a hundred years ago, and without which we could not have our modern motors or generators, telephones or radios.

We know that a coil which carries current surrounds itself with a magnetic field whose strength depends on the amount of current in the wire and on the number of turns of wire in the coil. Thus, if the current is steady, the magnetic field, too, will be constant. Take now a second, separate coil, which is not connected to a generator or battery, but only to a current meter (ammeter). Let this second coil bathe in the magnetic field of the first. By experiment we find that *as long as the current in the first coil does not change,* the ammeter across the second coil does not show any flow of current in the second coil. That is, of course, not very surprising. But if the current in the first coil is *changed,* the surrounding magnetic

In order to operate electric trains with ordinary house

field changes too, *and then there is a flow of current in the second coil.* Technically we say that the change in magnetic field due to the first coil *induced* a current in the second. This induced current will stop as soon as the current in the first coil settles down to a steady value again.

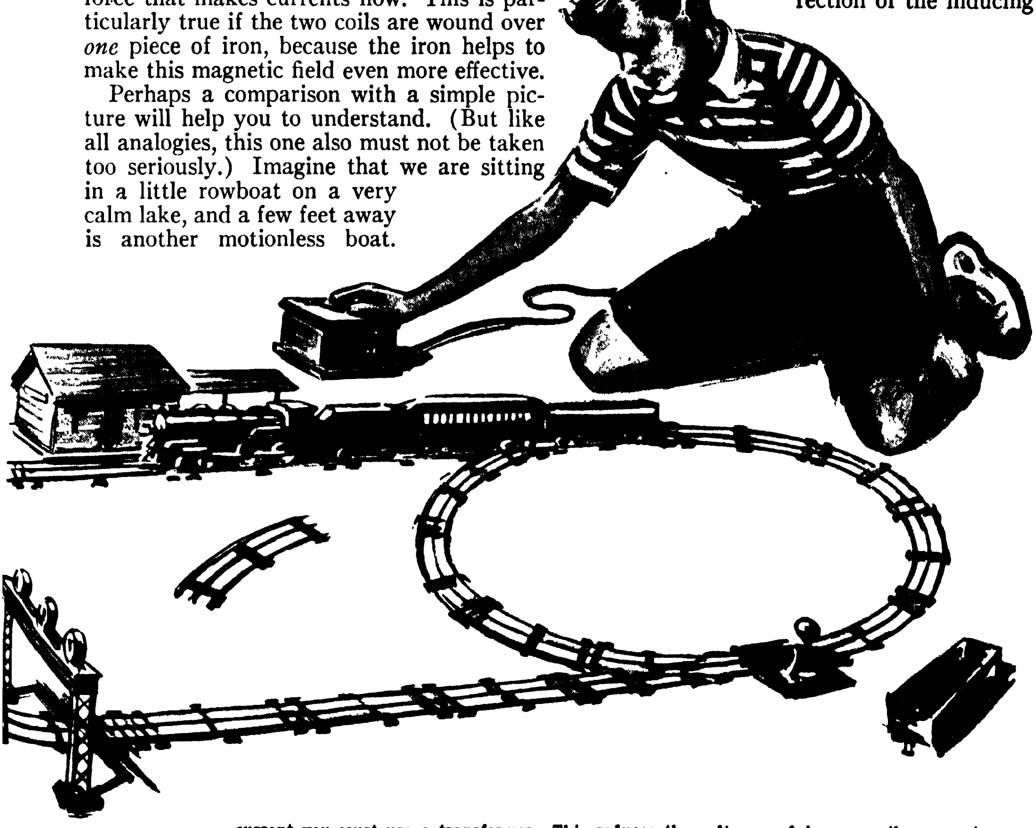
Of course we could connect the first coil, often called the "primary," to a source of alternating current, instead of direct current. Then the current (and therefore its magnetic field) would change *all* the time, and a correspondingly changing current would all the time be induced in the second coil, or "secondary." The name given to such an arrangement of two coils is "transformer." We shall see the reason for the name very soon.

We have now found a surprising thing! We can make current-flow in a (secondary) coil without even connecting that coil *directly* to a current source. It is as if the *changing* magnetic field around the current in the "primary" coil were somehow able to transfer from one circuit to the other the electric force that makes currents flow. This is particularly true if the two coils are wound over *one* piece of iron, because the iron helps to make this magnetic field even more effective.

Perhaps a comparison with a simple picture will help you to understand. (But like all analogies, this one also must not be taken too seriously.) Imagine that we are sitting in a little rowboat on a very calm lake, and a few feet away is another motionless boat. This is like our two coils on the table. Now suddenly our boat begins to leak a little; water flows in slowly, and our little boat begins to sink. The second boat will of course not be disturbed, just as a steady flow of current did not affect the "secondary."

But now we take a small bucket and empty the water that is in our boat by scooping it up and pouring it over the side. If we scoop just fast enough to stay afloat, our boat will rise up and down as we pour water out and it flows in again. Now the lake will transmit our motion by waves on the surface to the second boat. It will also begin to bob up and down. Our *changing* motion is passed on through the surrounding water, just as the changing current was "transmitted" through the magnetic field!

There are, of course, many interesting things about our coils which do not appear in this analogy. For instance, it is a fact that the induced current always flows in a direction opposite to the direction of the inducing



current you must use a transformer. This reduces the voltage and increases the current.

A lightning flash is current flowing through a gas. Electricity also flows in a liquid, as it does in electrolysis; or in a solid, as through a telegraph wire.

current. Therefore, the magnetic field that the secondary sets up around itself will be opposite to that of the primary. The more elaborate statement of this rule is known as Lenz's Law; and it is rather similar to many laws of nature, for it shows that the *effect* often opposes what *caused* it. This may seem a strange rule; but actually it is very necessary, because if an effect helps the action that caused it, the effect will become greater and greater without limit. In our coils, more and more current would flow in the secondary if its own field helped to increase the current in the primary instead of opposing it—and so the wire would quickly burn out!

Luckily we can predict exactly the value of the currents that will flow. If the primary and secondary coils are quite close together, so that the action of the magnetic fields is as strong as possible, then the ratio of the currents in the two coils has this relation to their number of turns of wire:

$$\frac{\text{Current in 1st coil}}{\text{Current in 2nd coil}} = \frac{\text{Number of turns in 2nd coil}}{\text{Number of turns in 1st coil}}$$

This means, of course, that we can get a lot of current out of the secondary coil of the transformer only if it has very few windings. Indeed, this is one of the functions of a transformer: It can change a weak alternating current in the primary coil into a strong alternating current in the secondary, or the other way around.

A "STEP UP" IN CURRENT IS ALWAYS ACCOMPANIED BY A "STEP DOWN" IN VOLTAGE

That seems almost like getting more out of the transformer than we put in—a thing you know to be impossible. The truth is that while a transformer may "step up" the current, it will at the same time, and to the same extent, diminish the voltage, the force that pushes the current. To use again a picture of the flow of water, a transformer can change a shallow but wild and dashing mountain stream into a deep but slow and lazy river in the valley. If we should want those two flows of water to work for us by driving a water-wheel, we should find that the total powers supplied from both currents of water are about the same. But for some uses and with some kinds of water-wheels we should prefer one or the other. the fast stream or the slow river.

This is very similar in electricity; sometimes we want large voltages but can do with small currents, and for other applications we may need large currents at small voltages. For instance. it is much easier to *send* small

currents at very great voltage through the wires from the power company to our house; but then it is much more economical and safe to use low voltages and large currents in our heaters and lamps. Therefore we use a transformer to make this change where the electricity comes into our house. (But remember again—a transformer works only with alternating current, not with direct current. That is one of the reasons why the use of alternating current has become so much more popular.)

CAN WE HAVE ELECTRIC CURRENTS IN GASES?

When we looked at the chemical effects of currents we dealt with the flow of electrons through liquids. Later we talked about electric currents in solids, like wires. We can also have currents in gases. A stroke of lightning, rushing from a highly charged cloud to the earth, is such a sudden current through the air. But ordinarily gases are very poor conductors; it takes very high voltages to overcome their electrical resistance and so to start a current.

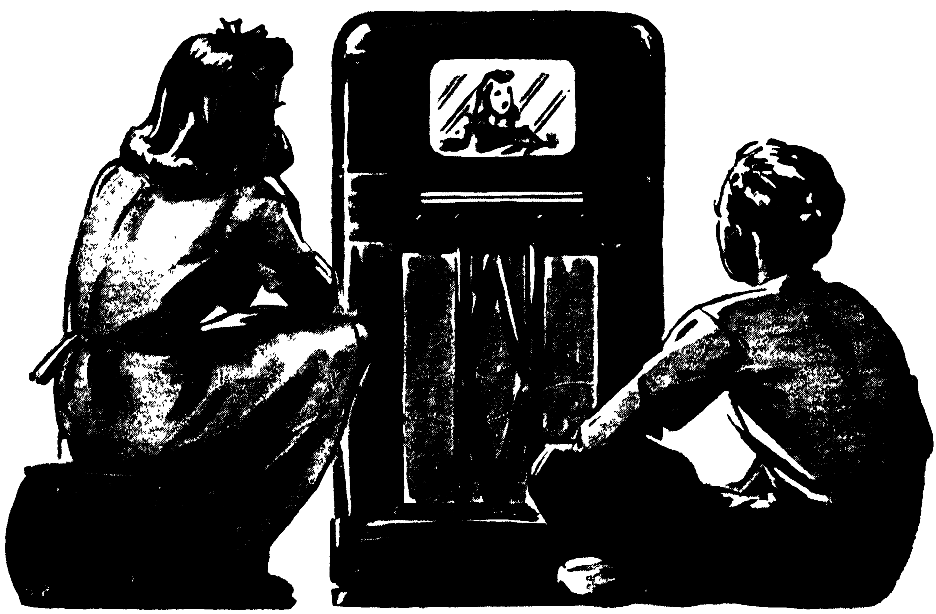
If, however, we evacuate a glass tube of all air, and then put in just a little gas (such as neon) at low pressure, electricity will flow more easily through the gas. Furthermore, in colliding with the gas molecules, the electrons that make up the current will cause the gas molecules to emit light which glows with colors very characteristic of the kind of gas in the tube. You have seen this "glow discharge" of electricity through a gas very often—the neon signs used for advertising are examples of this luminous effect of currents.

Neon gas by itself produces an orange-reddish glow. The differently colored neon signs you see are made possible by coloring the glass tube or by adding quantities of other gases to the neon.

When the pressure of gas in the glass tube is made so low that the electrons in the current collide only very rarely with gas molecules on their way through the tube, they may gain such velocities that very astounding things happen when they finally do hit something. These powerful electrons, falling on a special coating on the inside of the tube, may cause the coating material to fluoresce (send out light). Thus a beam of electrons can "paint" a pattern on such a fluorescent coating, and that is used for radar and television.

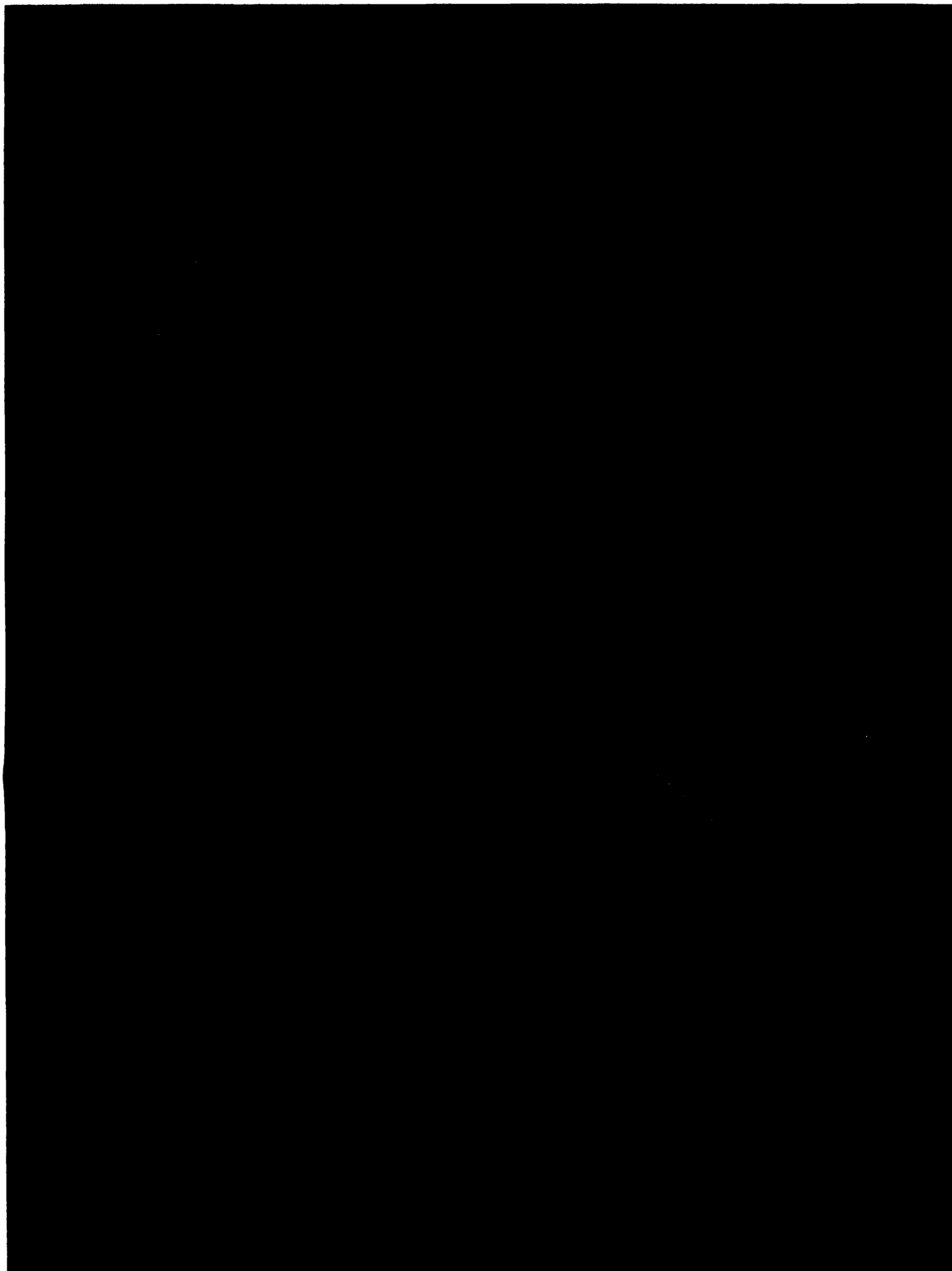
If those high-speed electrons are made to fall on a metal "target" they can cause the metal to send out X-rays, which doctors find so useful. *By* GERALD HOLTON.

THE NEXT STORY OF SCIENCE IS ON PAGE 4088.



When a beam of electrons hits a certain kind of fluorescent coating, a glow of light is given off. That is what happens in a fluorescent lamp, and also on a television screen, where electrons "paint" a picture.

THE TRAIL OF A METEOR IN THE SKY



Courtesy, Norman Lockyer Observatory

The pattern followed by a meteor as it sped through the atmosphere near the North Pole of the heavens. The film was exposed for over two hours. Note how the brightness of the meteor changed at different portions of its travel.

The constellation Leo on its journey across the sky during a night in March. You are looking toward the south.

THE DOME *of the* HEAVENS

WHEN we look up into the sky, either by day or by night, we can not judge the distances—the blue sky of day seems far off, so do the stars by night. If there are clouds, we see that they are high; sometimes there are clouds at different levels and then we can see that some are higher than others. Beyond the highest clouds we find the sun and moon and stars.

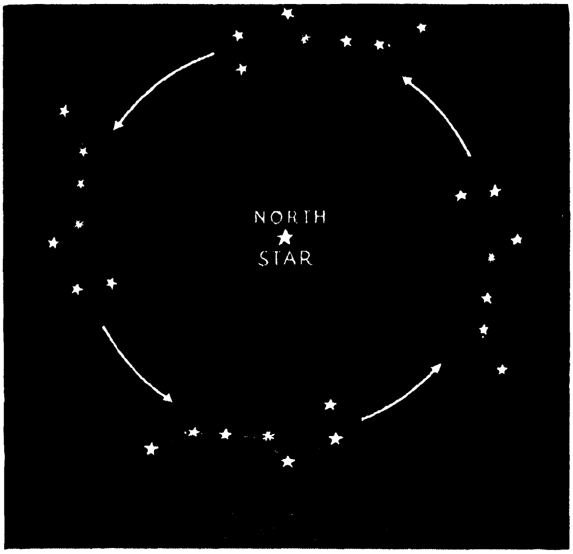
The clouds may go in any direction; sometimes there will be two layers traveling in different directions. But the sun and other bodies in the sky have definite tracks upon which they run. They must do so, because the motions of each of these heavenly bodies are part of the law of motions in the universe; while the clouds are simply floating in our air, as chips float in water.

Everyone knows that the sun rises and sets; yet many people have never realized that the stars rise and set, also. You can watch this, if you will. Look up toward the eastern heavens and find a good star that stands low in the sky; one or two hours later, the same star will be higher than before. Over in the west, a star that stood low when you first looked will have set, while those that were high will now stand low. The stars march majestically across the sky, rising and setting, and making one journey all the way around each day and night.

The cause of this is, of course, the turning of the earth on its axis. The earth spins, as a great top, and everything on the earth travels constantly eastward because of this spinning. If you stick a knitting needle through a large rubber ball and spin the ball on the needle, you can demonstrate many of the things that are so important to this story of ours.

First, think of one end of the needle as the North Pole and the other end as the South Pole. Really, of course, the Poles of the earth are places on the ball where the needle comes out. If you hold the needle in such a way that it points toward a corner of the room, you can call that corner of the room the North Star. The north end of the earth's axis always points, in our time, very nearly toward the North Star. As the earth spins on its axis, the axis continues to point nearly toward that star. If you were at the earth's North Pole, the North Star would stand overhead.

Halfway between the North and the South Poles of the earth is an imaginary line all the way around the earth; this we call the earth's Equator. Suppose you were standing on the earth's Equator; the North Star



Called the Big Dipper because of its shape, this group of stars turns around the North Star once every twenty-four hours.

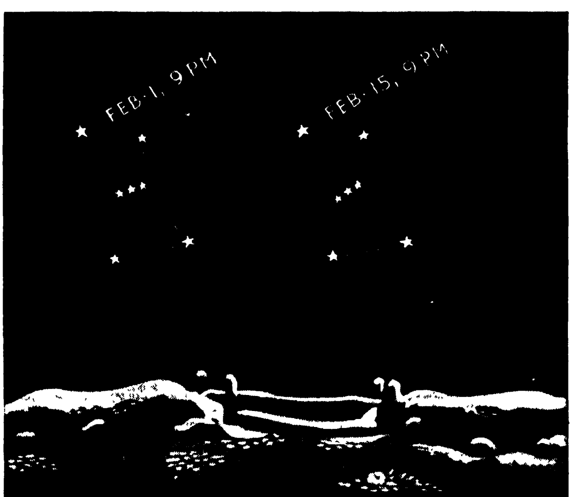
would no longer be overhead. It will help here if you attach a little square of heavy paper to a point on the equator of the ball. Make the square about as big as a postage stamp, and attach it only by its middle, so it is a flat square that will serve as your horizon at the equator. The horizon is as far down as you can see; it is the place where the earth and the sky seem to meet, in nature's scheme of things. When you have the horizon attached, and hold the axis so it points to that corner of the room, you can see that if you were at the Equator the North Star would seem to lie on the northern horizon.

If you are south of the Equator, you can not see the North Star; it is below the horizon. By using rubber cement to attach the horizon square to the ball, you can remove it and restick it at various places on the ball, to see how things are at various places on the earth. You will learn a lot in this way. In particular you will begin to realize that the sky changes as we travel north or south on the earth.

At the North Pole, the North Star appears to stand overhead. It is not exactly in the zenith—not precisely overhead—because the north end of the earth's axis does not point precisely at that star. But it is close to the zenith. If you are a short distance from the earth's North Pole, the North Star seems to be a little way away from the zenith. The farther you go from the earth's North Pole, the farther the North Star seems to be away from the zenith. For us who live in the United States and southern Canada, or for anyone who is a little less than halfway up the world from the Equator toward the North Pole, the North Star appears to stand a little less than halfway up the sky from the northern horizon.

Attach the horizon square to the ball a little less than halfway from the equator to the north pole. Stick a pin in the middle of the horizon square. Stand the pin up straight, and let the pinhead be your head. As you turn the ball, your head points to various parts of the room. Just so, as the earth rotates your head points to different parts of the heavens. To be sure that you start your thinking off in the right way, whenever you spin or rotate the ball, do it in the direction west to east, for that is the direction of the earth's rotation.

If you ride along a road in an automobile, the fence-posts and houses seem to stream in the opposite direction. That is, if you travel southward, the landscape seems to go north. In the same way, as the earth



The stars slip westward by almost four minutes every day. This diagram shows Orion (a constellation in the southern sky in February) as it appears two weeks apart.

rotates from west to east the stars and everything else in the sky appear to travel from east to west. As each star appears above our horizon, we say it is rising; the star does not actually rise, but the horizon in the east dips down far enough to expose the star to view. In the same way, in the west the horizon is always lifting upward, and when it covers up a star we say the star is setting.

You can try this out with a horizon that you can attach to your head. Cut out a large piece of cardboard, with a hole in it big enough to slip your head through. That is, slip your head through it until it rests on your ears and comes just beneath your eyes. Then you can see only what is above the horizon. Tilt your head over on your right shoulder; slowly straighten up and continue tilting until your head is over on your left shoulder. As you do this, you will see objects disappearing below the horizon at the right and others coming into view above the horizon at the left.

If you were at the North Pole, you might watch a star that is a little distance away from the North Star. It would travel in a little circle around the zenith as a center, all the way around in twenty-four hours. A star at a greater distance from the North Star would travel around in a larger circle. All the stars that you were able to see would circle the sky parallel with the horizon, none rising and none setting.

At the Equator, you would see a star in the east rising straight up, passing through the zenith and going straight down in the west. A star a little north of east would pass a little north of the zenith and set a little north of west.

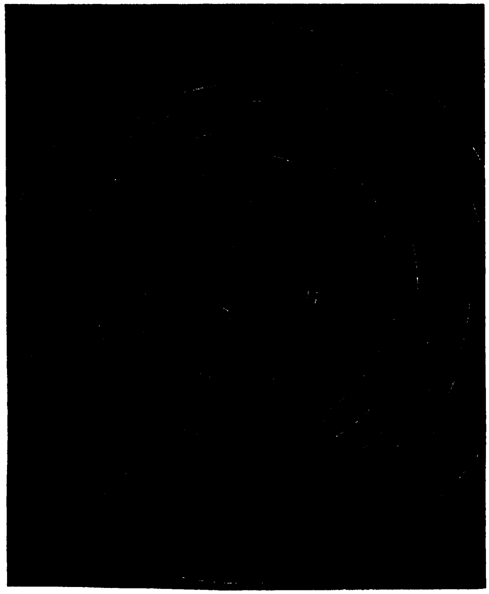
We are between the North Pole and the Equator, so what we see is between these appearances just described. A star that rises exactly in the east moves to the right as it climbs; it travels upward and to the right along a slanting path. At length it reaches its highest point, about halfway up the sky in the south. Then it descends in the west along a path that is a reflection of its path as it rose. As it sinks lower, it moves to the right along a slanting path.

Up in the northern sky, the North Star seems to stand still all night, every night. Actually, it is traveling in a small circle that is about wide enough to fit five moons inside it, edge to edge in a line; but without some careful measurement you will not notice that it travels. The other stars in the northern heavens seem to travel in circles around the North Star.

Stars that rise in the northeastern part of the horizon climb up to the right and pass near the zenith at their highest point. Then they descend to the right and set in the northwest. Stars that rise in the southeast climb less than halfway up in the south at their highest, and set in the southwest.

What is true for the stars is, of course, also true for the sun or moon or planets. None of these bodies is ever in the north, but all of them can rise exactly east, somewhat north of east or somewhat south of east. Any object, whether star or planet or sun or moon, always sets as far north or south of west as it rises north or south of

Where you will see Leo, looking west on June 15 at midnight, on July 1 at 11 P.M., on July 16 at 10 P.M., and on August 1 at 9 P.M.



Courtesy, Yerkes Observatory

This photograph was made by pointing a camera towards the northern sky and leaving it in the same position for about an hour. The earth rotates during the exposure, causing the stars to make trails on the film.

east. This is a definite rule of the heavens.

A star that rises exactly in the east will set exactly in the west just twelve hours later. Stars that rise south of east will remain above the horizon less than twelve hours; some that barely peep above our southern horizon are up for only a few minutes.

The stars that rise north of east remain above the horizon for more than twelve hours; the farther north they rise, the longer they remain above the horizon. Some stars never set for us. These are the ones far up in the north. Look at the North Star; now look down below it, on the northern horizon. Now imagine a circle drawn around the North Star as a center; the radius of the circle will be the distance of the North Star above the horizon. No star inside that circle ever sets; they are always above our horizon and can be seen every clear night of our lives.

Down below the southern horizon there is a cap of stars equally large, however, that we never see. In order to see these stars that never rise for us at home, we must travel southward on the earth. Only when we have gone all the way to the Equator can we see all of them. For an observer on the earth's Equator, every star in the sky rises and sets, spending twelve hours above the horizon and twelve hours below it.

Only by frequent observation of the sky can you grow accustomed to the way the sky behaves. Always look at the stars in the early evening, then at least once or twice more before going to bed. In a little while you will understand just how things work. You may even be a good enough observer to see the steady slow march of the stars resulting from the earth's motion around the sun.

All we have said earlier about the sky motions has been due to the rotation of the earth—its spinning on its axis. Another important motion of the earth is its yearly journey around the sun. We revolve around the sun in a great path known as the earth's orbit; it is almost a circle, and we go all the way around once in one year. On each and every day in the year we find ourselves in a different direction from the sun. Accordingly, on every day it appears that the sun is at a different direction from us.

Again we can see how this is if we think about familiar things. Put a lamp in the center of the room, on a table. All around the room, the pictures and the furniture will represent stars and groups of stars. The lamp is the sun, and you are the earth. Now you are going to revolve around the sun. Wherever you stand, at the table, some of the pictures and furniture will be over on the other side of the lamp; in nature, also, there

are always stars over beyond the sun. We can not see them because the bright sky of day blots them out. When you face away from the lamp, you see other pictures and furniture. These are the stars that you can see at night, when the earth is at a certain point on its yearly journey.

Now go over to the other side of the table. The lamp is in line with these latter stars, so they can not be seen. The ones that were in line with the lamp when you first looked are now opposite the lamp and can be seen.

As the earth revolves around the sun, the sun appears to revolve around the earth, all the way in the course of one year. The sun appears to move eastward against the background of the stars, a little bit each day. Another way to think of it is that the stars slip a little westward with respect to the sun each day.

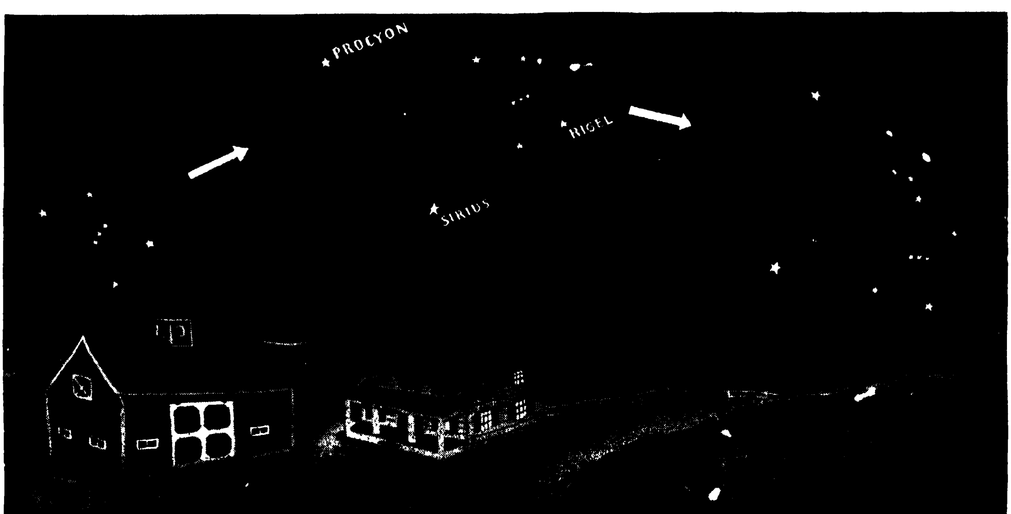
Go out early in the evening, some clear night, just as the sky is growing dark and the first stars are shining out. Look into the west and see just what stars are there. It is a good idea to make a sketch, putting in the trees and houses that you see, and the stars as they stand above these things on the earth. About a week later, go out and look in the same direction from the same spot, at the same hour of the evening. You will find that the stars are lower down; they have slipped westward a little, and you would have to look about half an hour earlier in order to discover them in the same places that they occupied when you made your first sketch.

The stars slip westward by almost exactly four minutes each day. So if you find a certain star in a certain place in the sky tonight, you must look four minutes earlier tomorrow night to find that star in the same place. On the following night, you must look four minutes earlier still, and so on, four minutes each night, until, after a month has passed you must look two hours earlier to see the same sky. The sky at midnight tonight is the same as the one you will see at 10 P.M. a month from now, and at 8 P.M. two months from now.

In the course of a whole year, the sky has slipped all the way around once, westward, and the same stars return to the same positions in the sky at the same moment. That is, if tonight you see a certain bright star just above the chimney next door at 10 P.M., that same star will be in the same position a year from tonight at 10 P.M. The year after next it will be there again, and so on through your whole life. That is a very comforting thing about the stars; they are dependable and you can be sure that they will not disappoint you some year. Once you have learned them, you do not need to learn new ones all the time; the old ones come back in their proper seasons.

By Roy K. Marshall.

THE NEXT STORY OF THE EARTH IS ON PAGE 4223.



How Orion and his companions move across the sky in a night. You are looking south, so the movement is westward. You can always recognize Orion by the three bright stars, quite close together, that form his belt. Rigel marks one of his feet. Sirius is in the head of the Big Dog, a neighboring constellation. Procyon is in the Little Dog.

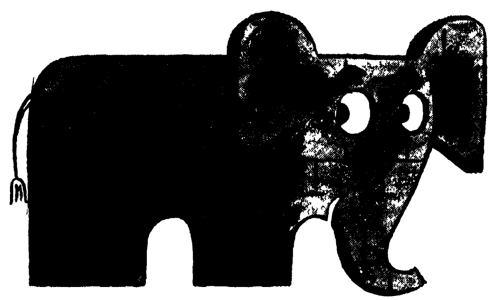
The Blind Men and The Elephant

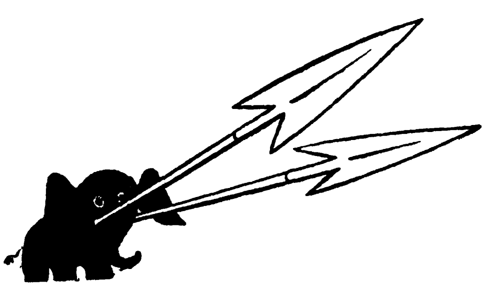
By John Godfrey Saxe (1816-1887)

Drawings by Alajálov

It was six men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind.

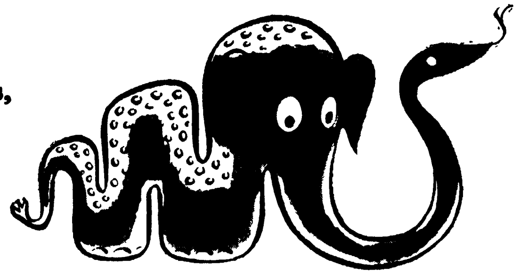
The First approached the Elephant,
And happening to fall
Against his broad and sturdy side,
At once began to bawl:
"God bless me! but the Elephant
Is very like a *WALL!*"





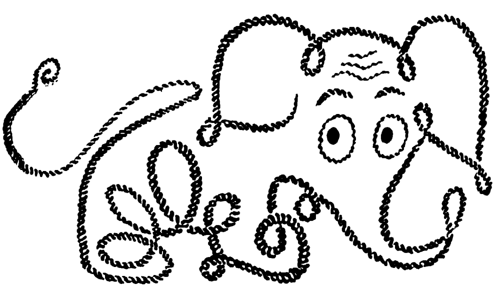
The Second, feeling of the tusk,
Cried, "Ho! what have we here
So very round and smooth and sharp?
To me 'tis mighty clear
This wonder of an Elephant
Is very like a *SPEAR!*"

The Third approached the animal,
And happening to take
The squirming trunk within his hands,
Thus boldly up and spake:
"I see," quoth he, "the Elephant
Is very like a *SNAKE!*"



The Fourth reached out an eager hand,
And felt about the knee
"What most this wondrous beast is like
Is mighty plain," quoth he:
"'Tis clear enough the Elephant
Is very like a *TREE!*"

The Fifth, who chanced to touch the ear,
Said: "E'en the blindest man
Can tell what this resembles most;
Deny the fact who can,
This marvel of an Elephant
Is very like a *FAN!*"



The Sixth no sooner had begun
About the beast to grope,
Than seizing on the swinging tail
That fell within his scope,
"I see," quoth he, "the Elephant
Is very like a *ROPE!*"

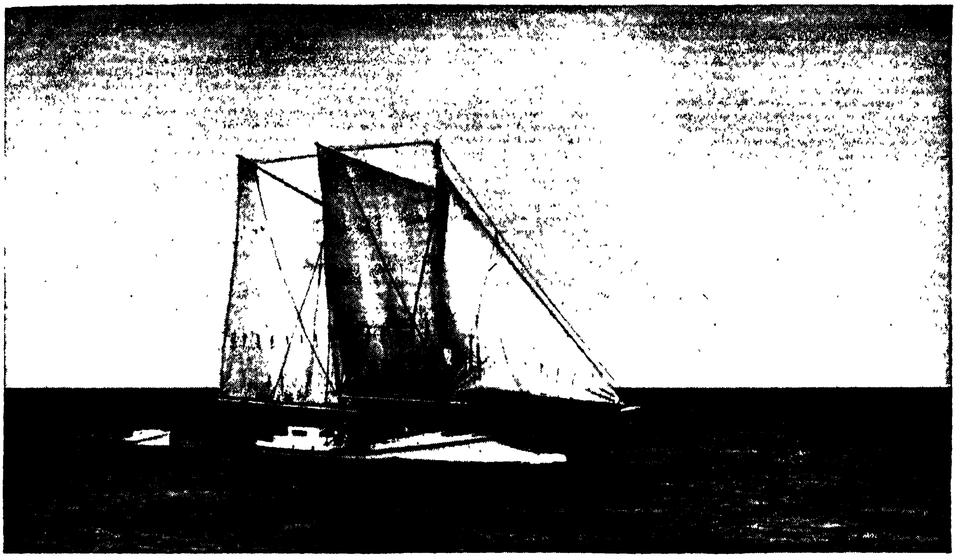
And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right,
And all were in the wrong!

THE NEXT POEMS ARE ON PAGE 4269.

CATCHING FISH NOT FAR FROM SHORE

Ewing Galloway, New York

This scene off the coast of Florida shows a pound or weir net, which is a long fence of netting supported on stakes, built out into the water at a right angle to the shore. The fish are stopped by the fence, and swim along it till they come to an opening. This opening leads to a pound, or trap, of netting. The fish are trapped here. The fishermen go out in boats and gather in the "catch."



Courtesy, North Carolina Department of Conservation and Development

THE WORLD'S FISHERIES

LIVING creatures are to be found in almost every part of the waters that cover some three-quarters of the earth's surface. These creatures range in size from the huge whale, the largest of living things, to tiny planktons which can be seen only through a microscope. In between these two extremes there are all kinds of life—fishes, seals, lobsters, clams, sponges and many other forms. They make up about 19,000 different species in all. Man has used a certain number of these species—a comparatively small number—for food, for medicine, for adornment, for plant food and for various other purposes.

To the harvesting of the products of the sea we give the name of fisheries. The term applies not only to the catching of fish but also to the hunting of whales, seals and other mammals that live in the sea. It refers to the catching of molluscs, such as clams and oysters, and of crustaceans, such as lobsters and crabs. It even includes the gathering of sponges, pearls and corals, for these, too, come from sea creatures living or dead.

From the earliest times man fished for food and used shells and coral as ornaments. In antiquity fish was a favorite article of food with the Egyptians, the Greeks and other peoples who lived on the shores of the Mediterranean Sea. Such fish as eels and lampreys were considered great delicacies in the days of the Roman Empire. There was a thriving trade in these fish between Rome and the rest of the Empire.

In medieval times the possession of great fisheries often meant political power as well as prosperity. The rise of Venice was due in great part to the fishing activities of her earliest inhabitants, who had sought refuge in her lagoons from the Huns. From the herring fisheries of the Baltic was born the mighty Hanseatic League (see page 1944). Fisheries also contributed much to the power of England and Holland in the Middle Ages.

Soon after John Cabot discovered Newfoundland, toward the end of the fifteenth century, the fishermen of England and France and other countries crossed the Atlantic Ocean and descended upon the fishing grounds between Cape Cod and Newfoundland. They caught great quantities of cod, haddock, mackerel and other fish. The early settlers of North America also found abundant supplies of fish in the inland waters of the continent. The fact that food fish were so abundant was one of the chief factors in the astonishing growth of the colonies of the New World.

To-day the world's fisheries are one of its important industries, with an estimated value

Courtesy, New England Council

Nets drying on racks. Nets are made of twine which must be strong and must not rot easily, for a net is quite expensive.

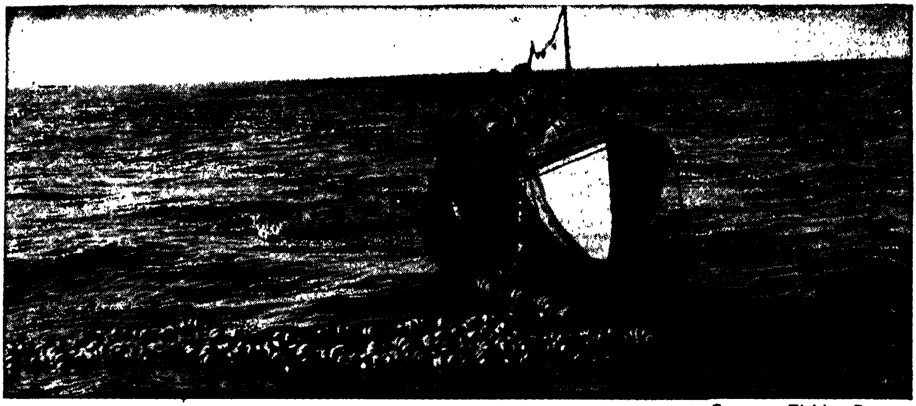
Courtesy, New England Council

Fishermen at Boston's famous old T Wharf are putting bait on their lines before starting off on a fishing trip. Notice how neatly the lines are coiled inside the baskets, with the hooks hung in rows around the rims.

of $600,000,000. Millions of people are employed in the industry. Not all of these, of course, are fishermen. In addition to those who actually catch the fish, there are others who manufacture fishing tackle (equipment used in fishing) and who prepare the fish for the market after they have been caught.

The products of the fisheries are taken in comparatively shallow waters. There fish and other sea creatures are plentiful because there is abundant food and suitable spawning grounds (where little fish are hatched from fish eggs). Fish are rarely taken at depths greater than 200 fathoms (a fathom is six feet), and most fishing is carried on at depths up to 100 fathoms. If these figures seem high, we must remember that the average depth of the ocean is about 2,000 fathoms, and that in some places it is more than 5,000 fathoms deep.

Much fishing is carried on in rivers and ponds and in the sea areas fairly close to the shores of lakes and oceans. There are other comparatively shallow areas, however, at a considerable distance from the nearest land. These areas are often known as banks. Among the most important are the Dogger Bank in the North Sea, the Bank of New-



Courtesy, Fishing Gazette

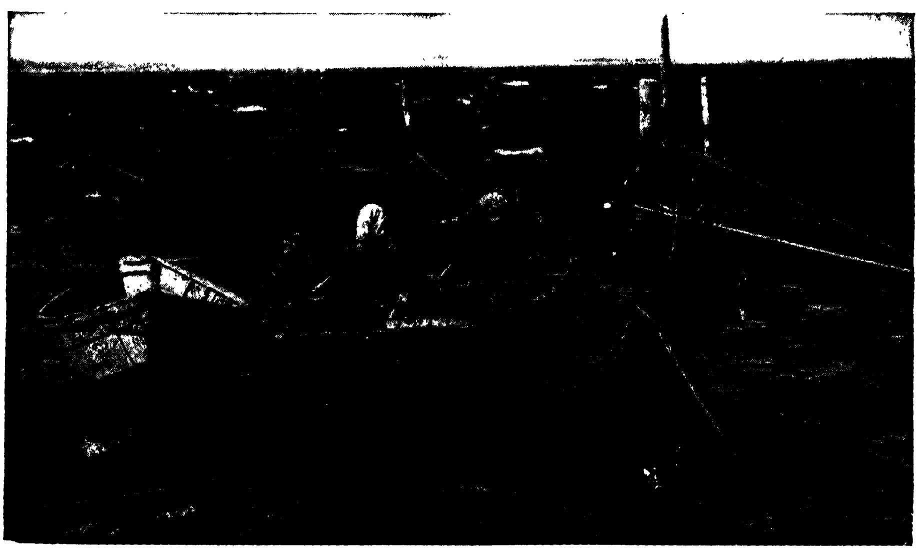
Catching mackerel in a seine. This is a long net with weights at one edge to make it sink and floats at the other. Men put the seine around a school of fish so as to enclose them.

foundland, also called the Great Bank, and the Bank of Iceland.

Many different methods are used to take the creatures of the sea. There are so many of these methods indeed, that in this article we can do no more than describe a few of the commonest ones.

In catching fish, men often work from boats. For commercial fishing (fishing for the market) carried on within twelve miles or so from land, small sailboats and motor boats are used. Larger vessels are employed for fishing carried on farther away from the shore. There are schooners that rely entirely upon sails; other schooners have not only sails but also engines, which drive the ships when the wind fails. Fishing schooners often carry a number of flat-bottomed rowboats, called dories. Finally there are boats called trawlers, which rely entirely on steam engines or Diesel engines.

The hook-and-line method of catching fish is widely used by sportsmen. It is also used by some of those who fish for the market. Sometimes fishermen working from boats throw out a number of single lines, which are



Courtesy, New England Council

This is another view of a pound, or weir, similar to that shown on page 4050. The word pound comes from an old Anglo-Saxon word meaning an inclosure. Our dog pound comes from the same word.

ON A NEW ENGLAND TRAWLER

A trawl net used in New England. The bag-shaped net, 150 feet long, has been dragged along the sea bed until it is full. Now it is ready to be emptied into the boat. Such a net will catch up to 6,000 pounds of fish. New England accounts for about one-fifth of the fisheries products of the United States and Alaska.

Pictures, courtesy, U. S. Bureau of Fisheries

Sorting the catch on board a New England trawler. Cod, haddock, soles and flounders are often taken by trawling. More than two-thirds of the fish brought into Boston each year are cod and haddock. Cod is one of the most important food fishes of the world.

drawn through the water as the boat moves. More often a long line is used. This is a fishing line with a number of shorter lines attached to it; each of these lines is baited.

When a school (a large number) of fish is located, a man (sometimes several men) in a dory rows out from the ship and anchors one end of the line, marking its position by a buoy. Then he rows off a certain distance and anchors the other end of the line, marking that, too, by means of a buoy. A number of long lines are set in position in this way. After a time the line is pulled in and the fish are taken off the hooks; then the line is set out again, after fresh bait has been put on the hooks. Long lines are used to catch such fish as cod, haddock and halibut; they are baited with herring, clams or squid.

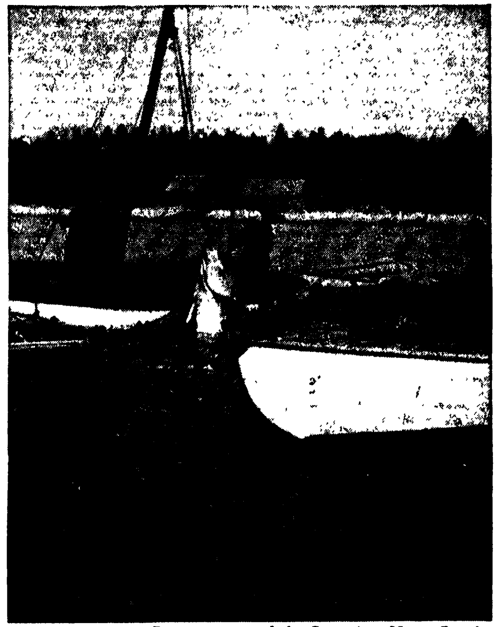
TRAWLS ARE BAG-SHAPED NETS THAT ARE DRAGGED ALONG THE SEA BED

More fish are caught in nets than by means of lines. The boats known as trawlers are provided with large bag-shaped nets, about 150 feet in length. These bags, which are called otter trawls, are dragged along the sea bed by means of ropes or iron chains attached to the stern (rear) of the trawler. The ropes or chains are attached at the mouth of the bag, which is kept open by the pressure of the sea as the net is dragged along. At regular intervals the net with its catch is hoisted on board by means of machinery. After being emptied of fish the net is put out again. Cod, haddock, soles and flounders are often taken by this method, which is called otter trawling.

THE SEINE, WITH WEIGHTS AT THE BOTTOM AND FLOATS AT THE TOP

Another kind of net is the seine, which is used to enclose large schools of fish. The seine is a long, rectangular stretch of net, which is set in position so as to form a sort of wall below the surface of the sea. There are weights at the bottom of the net; floats along the top keep the net from sinking. When a school of fish is sighted, the seine is put out from boats and run around the school. The two shortest ends of the net are brought together and the fish are now enclosed in a circular wall. To prevent the fish from escaping by diving under this wall, the bottom edges of the net are drawn tightly together by means of a rope passing through rings. As the net forms a sort of purse, in which the fish are imprisoned, this method of fishing is called purse seining. Mackerel are often taken in this way.

The fish may be unloaded into the boats directly from the seine, or else they may be dipped into the boats from the seine by means of a large scoop net. Sometimes one end of the seine is fastened by a rope to the ship, and the seine with its load of fish is hauled aboard.



Department of the Interior, Nova Scotia

These men at Hubbards, Nova Scotia, are killing a giant tuna, an excellent food fish.

Herring or mackerel that come close to the shore are caught by the method called drag seining. The seine is run around the school of fish; then the ends are brought to the shore and the net is dragged in, bringing the fish with it.

An interesting kind of net is the gill net or drift net. It is like a seine, except that it is not used to enclose schools of fish. It is set adrift, like a wall of net, across a channel or the entrance to a bay. The fish try to get through the meshes of the net but only their heads will go through. The meshes are too small for their bodies. They try to back out, and their gills are caught in the net. When the net has been set for some time, fishermen take it up (one section at a time), empty it of fish and then drop it back into the water to catch more fish.

Some fish are caught by fishing traps or weirs. The traps are of many different kinds, but they are all based on the same principle. A series of stakes is built out into the water, starting from the shore. A net is

SALMON FISHING IN THE PACIFIC NORTHWEST

Courtesy, U. S. Bureau of Fisheries

Pacific salmon are hatched in rivers and streams. The young live there for about two years, reaching a length of only six or eight inches. Then they swim down to the sea where they grow to great size, some kinds up to 100 pounds. After two years in the sea they return up the streams to spawn, and that is when they are caught.

Courtesy, Portland, Oregon, Chamber of Commerce

In both Canada and the United States (including Alaska) Pacific salmon fishing is an important industry. The work is seasonal; the salmon make their runs up the river between the spring and fall, often in such numbers that they almost choke the streams. This peaceful Sunday scene shows the nets drying.

Courtesy, Department of Fisheries Ottawa Canadian National Rys

Canada's lobster catch is the largest in the world Above we see fishermen loading into a boat traps, or pots, for catching the lobsters The traps are baited with fish and weighted Each one is lowered to the sea bed by a rope with a buoy at the end The buoy bears the owners private mark. The pots are visited daily.

attached to these stakes in such a way as to form a wall extending out into the sea at right angles from the shore. This is called the leader. As the fish swim along the shore, they find their way blocked by the leader. They swim along it, trying to find a way through the netting. An opening in the net at a considerable distance from the shore leads to a pound or trap made of netting. Once the fish are in the pound, they rarely find their way out again.

Salmon are generally caught when they enter the rivers from the ocean in order to make their way upstream, leaping rapids and falls, and spawn or lay their eggs. They are taken in various ways—by purse seines, drift nets, drag seines and weirs. They are also caught by trolling—that is, fishing with a hook and line from a boat. Formerly great quantities of salmon were taken by a device called a fish wheel. This was a large wheel with basket-like wire nets attached to its rim; it was set in the river. The current kept turning the wheel; the wire baskets dipped into the water in turn and scooped up the fish. As each basket would come up full of fish it would deposit its load in a trough leading to the shore. Fish wheels are no longer in common use.

Shellfish are taken in various ways. Lobsters are generally caught by means of baited lobster pots, which are wooden traps sunk in the water. These pots, which are several feet long, are often rectangular in shape; sometimes they are shaped like a half-cylinder, the flattened part being the bottom of the trap. Across one end of the pot a net is stretched. Bait is hung in the middle of the pot. The lobster crawls through an opening in the net to get at the bait; it cannot get out again.

On page 6888 we tell you the interesting story of the oyster, which attaches itself to a stone or shell at the bottom of the sea. Formerly anybody could take oysters from their beds. In North America, however, wasteful methods endangered the oyster supply and a halt had to be called. Nowadays

HOW OYSTERS ARE TAKEN

On an oyster farm, seed (partly grown) oysters are being scattered over a bed where food is plentiful and they will have a good chance to grow up.

Pictures, courtesy, Fishing Gazette

Men with tongs (double rakes) are bringing seed oysters from a shallow bed, and will transplant them in a better place, as in the left-hand picture.

Courtesy, U. S. Bureau of Fisheries

An oyster reef along the South Atlantic coast, at low tide. Oyster growing is generally carried on under government supervision. Most of the oysters raised in the United States come from the southern half of the Atlantic Coast, and the Gulf of Mexico, also from Long Island sound. The Pacific Coast has a much smaller oyster industry. In Canada, some oysters are secured from Chaleur Bay and around Cape Breton Island.

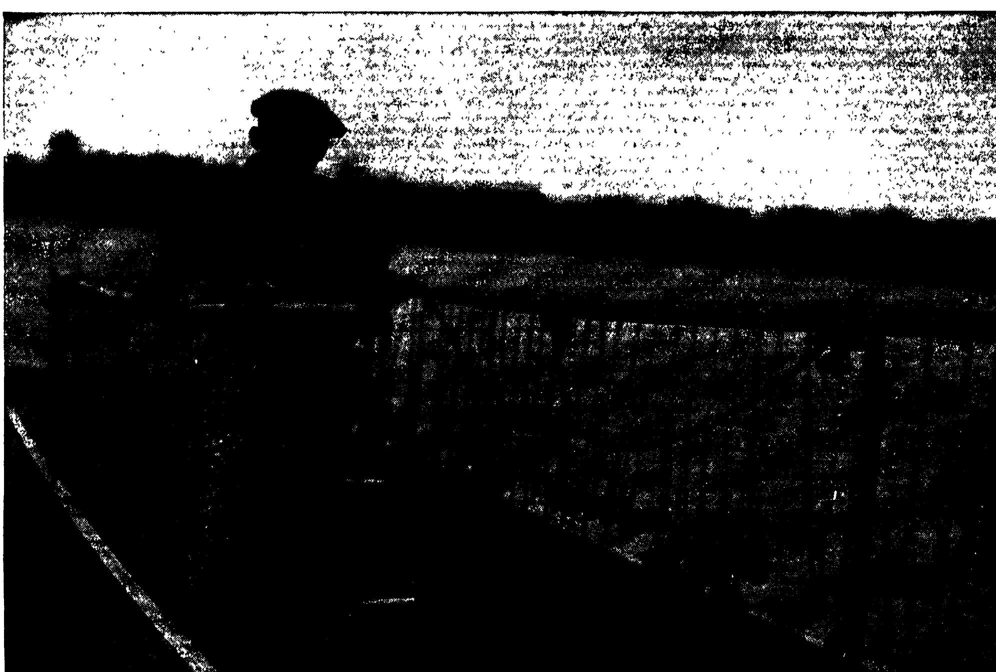
oyster beds are leased by the state to oyster planters—the name given to those who prepare oyster beds and take oysters for the market.

The oyster planter marks the site of his bed by means of buoys or stakes. If the bottom of this area is very soft, he scatters gravel or empty oyster shells over it. If there is an oyster spawning ground near at hand, the young oysters (called seed) will attach themselves to the gravel or empty shells. If there are no spawning grounds near by, the planter scatters partly grown oysters over the bottom. In France and Holland, the tiny oysters are carefully planted on earthenware tiles coated with lime. An oyster will spawn millions of eggs in a season, though only a small number will live and grow into oysters. Nevertheless an oyster bed will continue to produce plentifully for a number of years if the planter is careful and does not take out too many oysters.

Sometimes, several weeks before marketing, oyster planters transplant the oysters to shallower waters, where food is more abundant. The oysters fatten in these new quarters and their flavor is improved. In North America oysters are collected in shallow waters by means of tongs. They are taken in deeper waters by a dredge, drawn along in a power boat or sailboat. Scallops are also taken by means of dredges. Clams, abalones and certain other molluscs are dug at various places along the shore.

Pearl oysters (that is, oysters taken for the sake of the pearls they may contain) are gathered by naked divers in the Red Sea, the Persian Gulf and other places. They grease their bodies, put greased cotton in their ears and place a clamp on their nostrils; then they dive to the bottom. They pluck the oysters from the beds and put them in wicker baskets or nets hung at their waists. Diving suits are often used nowadays in taking pearl oysters in the Australian oyster fisheries and elsewhere.

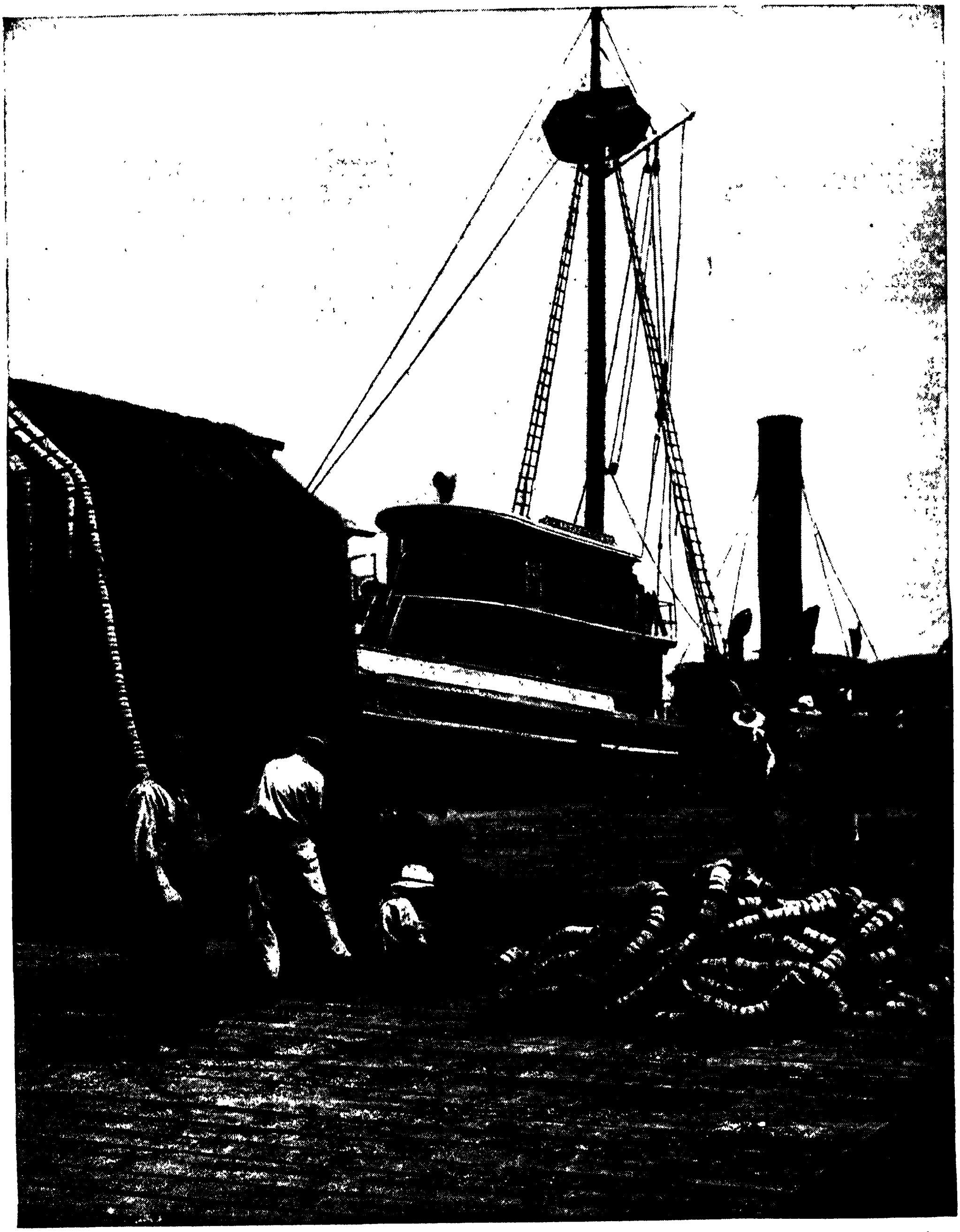
Whales were formerly hunted from small boats sent out from a mother ship; Moby Dick, a classic of American literature, gives a stirring picture of this old-fashioned method of whale hunting. Nowadays whales are generally hunted from steam-driven whalers (whaling ships). The whales are struck by harpoons shot from guns. They are drawn alongside and then towed ashore.



Kenneth M. Wright Photo

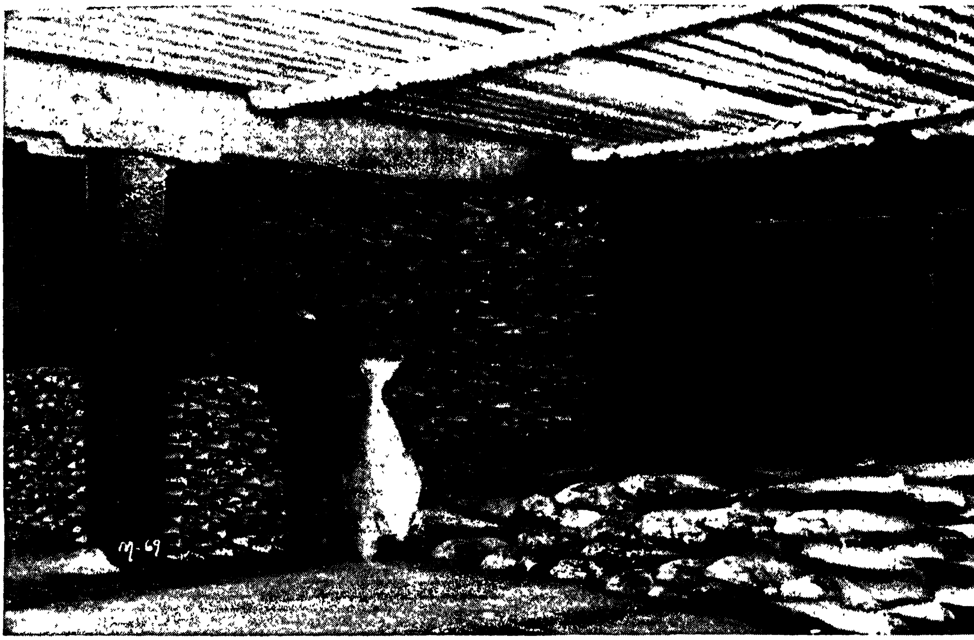
This is the type of rake used for gathering clams along the upper Mississippi River. In New England the clams are dug from the sand at low tide, by long-handled rakes and by tongs.

A FISH NOT USED FOR FOOD



Courtesy, Virginia State Chamber

A fish that is caught in great numbers, especially off the eastern coast of North and South America is the menhaden, or pogy. It has many other names, along different sections of the coast—hardhead, bunker or marshbunker, bay alewife, bug-fish or bug-head, and fatback. It is a member of the herring family, and has a large head and very oily flesh. It swims in large schools. It is caught in pound nets and purse seines, and used for fertilizer, bait and other purposes. The picture shows menhaden fishermen in Virginia.



Courtesy, Meline, Alaska Steamship Co.

The products of Alaska's fisheries amount to many millions of dollars annually. They include salmon, herring, halibut, cod and shellfish. Above is a cold-storage warehouse with frozen fish.

Certain large whalers are equipped to cut up the carcass and prepare it for the market. These are really floating factories.

Seals were formerly taken on the high seas. This is forbidden nowadays. They are now caught on land. They are rounded up in droves of 1,000 to 3,000 and driven inland to a place called the killing grounds; here they are knocked down by clubs.

We tell you about the taking of sponges elsewhere. See Sponges in the Index.

Fishery products are prepared for the food markets in various ways. When fish are caught for the fresh fish trade, the boats remain on the fishing grounds only a day or two and then they return with their catch. Of course this is impossible when fishing boats go out to the banks at a considerable distance from the shore. In this case, after fishing for the day is over, the crew split, clean and wash the fish and then store them in the vessel's hold. If the fish are to be used for drying, each layer of fish is heavily sprinkled with salt.

Great quantities of fish, such as cod, haddock, hake and pollack, are dried for the market. The drying takes place in the sun and air and may take three weeks or so. Less time is required if a part of the drying is done in artificial dryers. Herring, haddock, salmon, cod and other kinds of fish are often smoked. Herring and mackerel are sometimes pickled—that is, preserved in brine or in vinegar.

In recent years a process known as rapid freezing has come into wide use. Fish are frozen very quickly in tanks by means of a brine mixture. Fish prepared by this method retain the fine flavor and the firm texture that they had when first taken from the water. They will keep for months if properly handled.

A favorite process for preparing such fish as cod, haddock, hake, cusk and pollack is filleting. Fillets are broad pieces or slices of fish from which the bones have been removed. Both fresh and frozen fish are sold in the market in the form of fillets.

Oysters are a favorite article of diet in the United States and Canada. They are sold in various ways—on the half-shell (with one of the two shells removed), shucked (with both shells removed) or dried. Lobsters are often sold in the shell; the eater has the pleasant task of cracking the shells so as to get at the meat.

The canning of fish (particularly salmon and sardines) and of such shellfish as lob-

country makes the laws for the fishing activities carried on within its territorial waters —that is, all its inland waters, bays and gulfs (with some exceptions) and all waters within a distance of three miles from the coast.

In the United States the individual states make and enforce the laws regulating fishing. They establish closed seasons—periods during which fishing for a particular species is illegal; they set a limit to the size and number of fish that may be caught and they make other necessary regulations. The federal government intervenes only in a few cases.

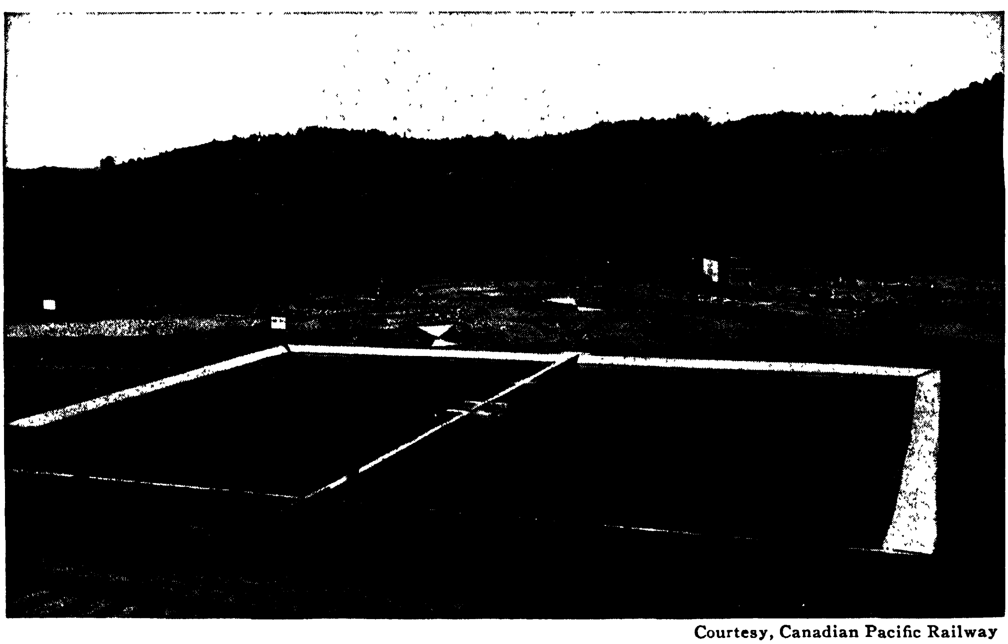
In Canada the fisheries regulations for all sections of the Dominion are made by the federal authorities. These regulations are enforced by the individual provinces in non-tidal waters—those not affected by the action of the tides (rivers, lakes and so on). Elsewhere Dominion authorities administer the fishing laws.

Beyond the territorial waters of the various countries of the world is the vast expanse known as the high seas. Here fisheries are governed by international law. The high seas are free to all. However, a country can protect the fishing rights of its citizens on the high seas by signing a treaty (often called a convention) with another country. Sometimes pacts of this sort are drawn up between more than two countries. Such was the famous convention signed in 1911 by the United States, Great Britain, Japan and Russia, prohibiting the citizens of any of these countries from catching seals on the high seas in the waters of the Northern Pacific.

Wise legislation has done much to preserve the fisheries of the world from the dangers caused by ignorance and carelessness. Modern science has also done its part to assure the world of a never-failing supply of fish and other sea creatures.

Fish grown in modern hatcheries are used to stock the streams and lakes where the fish supply has diminished. This method of increasing the fish population is effective, for the most part, only in inland waters. Such bodies as the Fish and Wildlife Service of the United States and the Department of Fisheries of Canada conduct investigations into the scarcity or abundance of fish in various regions and work out the best methods of catching and handling fish. They teach fishermen how to conserve the resources of the sea so that these resources may be enjoyed by future generations.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4185.



Courtesy, Canadian Pacific Railway

Wasteful methods of fishing in our lakes and rivers and along our coasts have cut down the fish population in certain places. Governments everywhere are now helping to put fish back into waters that were being "fished out." In this hatchery in Morrison, Quebec, baby trout are being raised to restock the streams of the province.

WHAT IS AN ATOM-SMASHER?

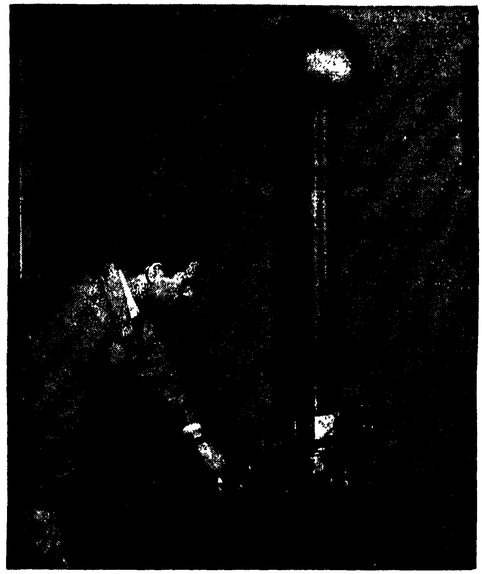
LESS than half a century ago, physicists and chemists began to suspect that each atom consists of two different parts: the nucleus at the core of the atom, and the electrons swarming around the nucleus. The exact paths and number of the electrons for each of the different kinds of atoms was no easy matter to discover, but that problem has now been fairly well solved. It is, of course, not possible actually to watch the behavior of the electrons—they are by far too small—but they give away the secrets of their presence and arrangement by the light that they send out, under special conditions, when they change positions around the nucleus.

With the mystery of the electrons solved, physicists began to wonder about the nucleus itself. What is it made of? What forces hold its different particles (called nucleons) together? How can one transmute (change) the atoms of one element to atoms of another element? These questions are not so easily attacked because the nucleus of an ordinary atom does not *do* much by itself. For example, it does not send out light when heated, as the electrons do.

Physicists know how to make the nucleus give up its secrets. Electrons or other subatomic particles are shot against the nucleus at very high speeds. From the deflection (turning aside) or loss of speed of these bullets, or from chips off the nucleus, the scientist can guess at the structure and forces within the core of the atom.

This may sound simple, but actually it took men of great genius to design machines that would provide bullets powerful enough to break or even dent an atomic nucleus. These machines are sometimes called atom-smashers. Physicists call them accelerators, because they accelerate the subatomic bullets to great speeds.

How do these accelerators work? There are several different types, but most of them rely basically on a principle that you can demonstrate for yourself some dry day. If you have combed your hair vigorously with a hard rubber comb, the comb will then attract a stray hair when brought near. We explain this action by saying that different electrical charges have been generated on the hair and on the comb, and that these



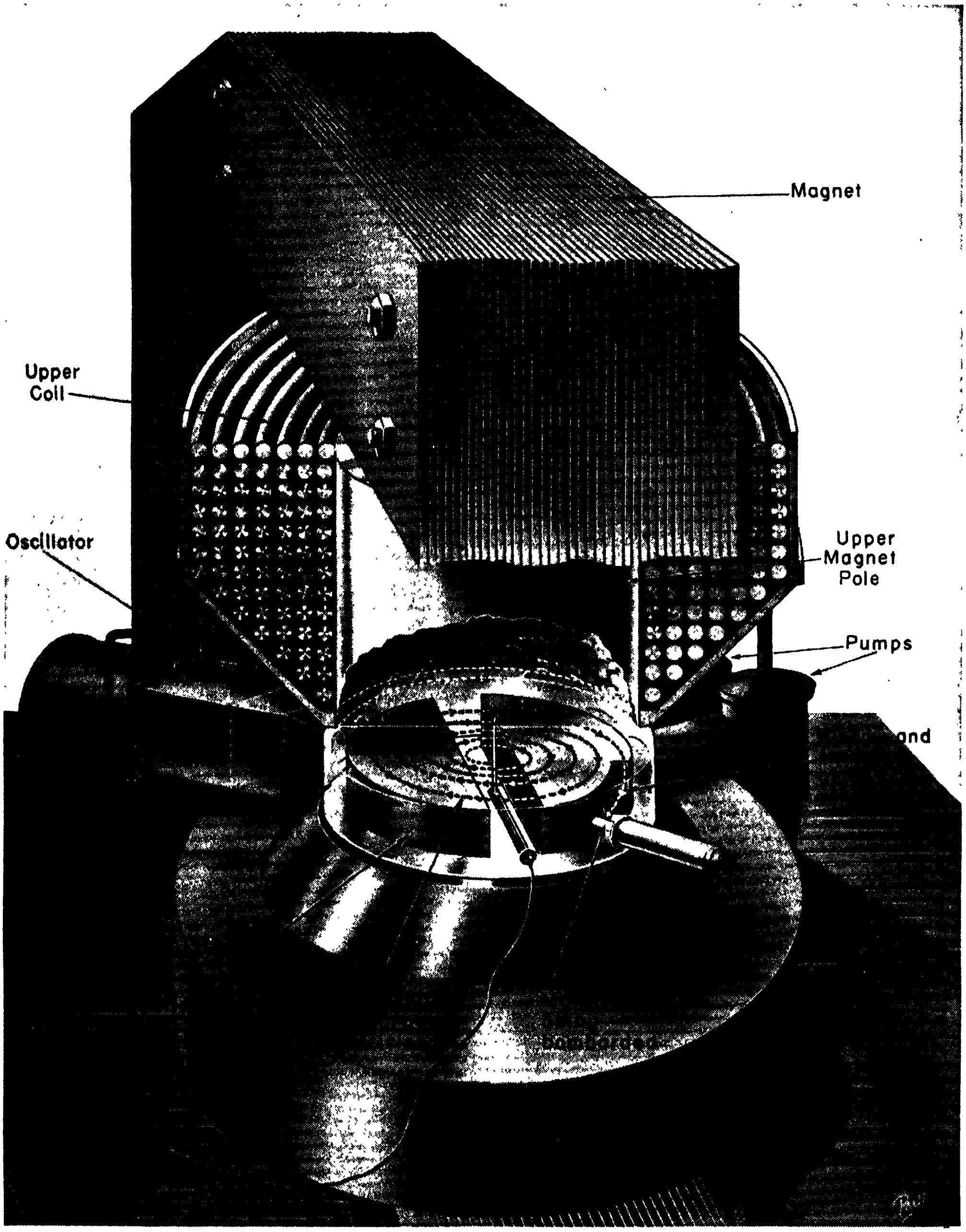
Courtesy, The Science Observer
An atom-smasher of the R. J. Van de Graaff type.

charges of different kind attract one another. Charges of the same kind would repel each other. All accelerators use charged particles (which are to be our projectiles). Most machines give high speeds to these particles by letting them be attracted by a differently charged body or be repelled from equally charged bodies.

Into the path of the fast-flying bullets we put the real target, the nuclei to be broken by the collision. Of course we must take care to keep all air and other gases out of the way of the accelerating projectile. Otherwise it will be deflected or slowed down. In each accelerator, therefore, you will find an airtight compartment exhausted of air, in which the particles can gather speed without interference.

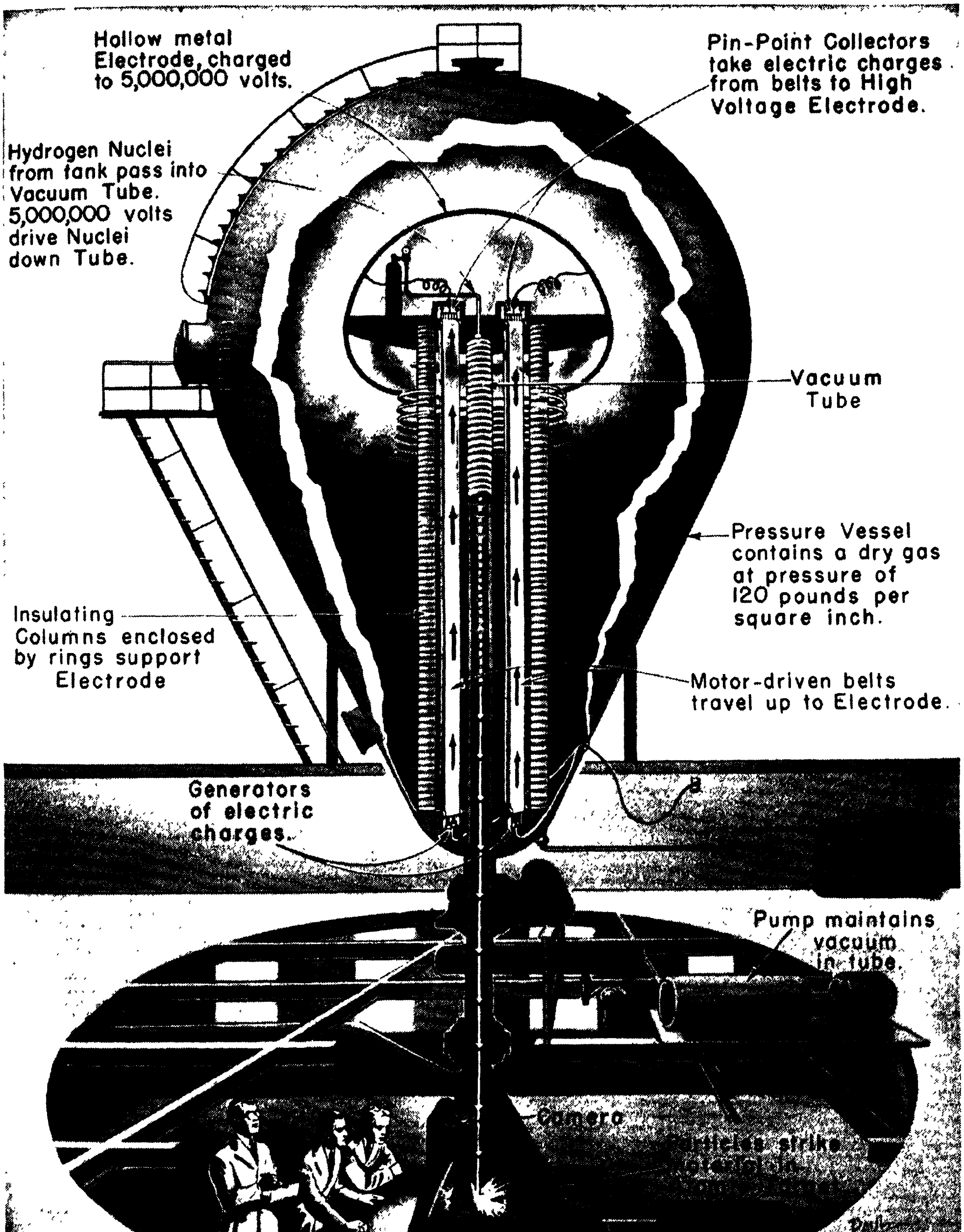
Some of the oldest atom-smashers are of a type called the Van de Graaff generator, named after its American inventor, R. J. Van de Graaff. The charged particles used as bullets can be the negative electrons (from a hot metal wire). Or they may be positive protons (hydrogen atoms which have lost their electron), positive alpha particles (helium atoms without their electrons) or any

THE CYCLOTRON—A MIGHTY ATOM-SMASHER



In the cyclotron the electrodes consist of two hollow half-cylinders, called "dees" (D's) because of their shape. They are set in a vacuum tank between the poles of a powerful electromagnet. Ions—charged atoms—are produced at the center of the small gap between the dees. As long as the ions are in the gap, they are attracted to one of the two charged dees by the electric forces between the electrodes. When an ion has entered the hollow space in the dee, the magnetic field of the big magnet curves the ion path circularly. Back in the gap, the ion is pulled into the other dee because the electric oscillator has reversed the charges on the dees in the meantime. This process is repeated many times per second; the ions keep moving in widening circles. At last they reach the outer part of one of the dees, emerge from a window and bombard their target (right center).

THE ATOM-SMASHER OF VAN DE GRAAFF



This atom-smasher, developed by R. J. Van de Graaff, of the Massachusetts Institute of Technology, is called an electrostatic generator. The pear-shaped tank in which the apparatus is enclosed is filled with air under pressure or with insulating gas; this makes it possible to bring about higher voltages than in the open air. The hollow metal electrode at the top—the cap—is supported by insulating columns. Running down from this electrode are the charging belts. A source of electricity sprays charges onto the moving belts. The belts carry the charges to the cap, and cause the cap itself to be charged. A vacuum tube extends from within the cap to the bottom of the apparatus. Atomic "bullets" shoot down this tube, driven by the great electric forces between the charged cap and the ground. These projectiles smash into the material serving as the target.

other fragment of an atom which has a charge. The preparation of these bullets is not difficult. It goes on right inside the vacuum chamber at the top end of a long vertical tube. The target can be at the other end. A large metal sphere is mounted right above the point where the charged bullets, say electrons, are being prepared. If this sphere is charged up very strongly with negative electricity, the electrons will be repelled with enormous force to the lower end of the tube. There they crash into the nuclei of the target material. If the particles to be used had been positively charged, the sphere would also have been positive.

When the sphere gets too much charge, it may spark over to the ground, just as a charged rain cloud sends a spark of lightning down from the sky. This is, of course, dangerous, and there is a limit beyond which even the biggest and best insulated Van de Graaff machines can not be charged. Though it corresponds to millions of volts acting on the projectile, and though the projectiles gather enormous speeds, all this is not enough to impress some of the nuclei to be bombarded.

A rather different atom-smasher was designed and built by Ernest Lawrence in California. It is the cyclotron.

In a cyclotron, the bullet (ordinarily a positively charged particle such as a proton) is made to go in a circle by putting the evacuated chamber containing the particles between the two poles of a very powerful electromagnet. A strong electric field is supplied in this chamber in such a fashion that the particles experience a strong push every time they cross from one half of the chamber into the other in their circular path. As the particles gather more and more speed, they make larger and larger circles. When they almost hit the walls of the round chamber, they pass out through a small window into an enclosure containing the target.

The speeds achieved in these accelerators are many times those in the Van de Graaff machine. The newest cyclotrons use some special tricks to increase the energy of the atom-smashing bullets and are called synchro-cyclotrons. So effective are they that particles called mesons have been knocked out of the target nuclei. Physicists hope that these mysterious newcomers to science will be the key to the puzzling behavior of the nucleus. Even now the atom-smashers are giving us many new clues about atomic structure. They do other things as well. For example, some accelerators use electrons to bombard metals in order to get very intense X rays for industrial and medical purposes. Other machines prepare artificial radioactive materials by bombardment. Yet others send their stream of particles against the cells of plants and insects to discover the effects on their growth.

By Gerald Holton.

THE NEXT WONDER QUESTIONS ARE ON PAGE 4131.

University of California

The giant University of California cyclotron. It fires deuterons, alpha particles or protons at its targets.

THE TALES OF SIR WALTER SCOTT

THERE is not in English literature any other series of books by one man that can compare in quantity or in quality with the Waverley Novels, written by Sir Walter Scott between the years 1814 and 1831. These wonderful tales of the past would fill about ten thousand closely printed pages, and the period of history covered by them is more than seven hundred years. A complete edition usually contains twenty-five volumes, and there are in all thirty-two stories. We must have some general idea of the whole series, so we shall begin by looking at the whole of this wonderful library before we turn to the particular books. Then we shall give an outline of Waverley: or 'Tis Sixty Years Since. This novel centres in the Jacobite rising of 1745.

THE WAVERLEY NOVELS

ALTHOUGH Sir Walter Scott's novels cover a period of more than seven hundred years of European history, we are not to suppose that he wrote them in the order of time. As a matter of fact, the very first of his stories described the life of only sixty years before his own day. It was called Waverley: or 'Tis Sixty Years Since, and dealt with the Jacobite rising of 1745. The story that goes farthest back into history was one of the last two he wrote in the year 1831. It is called Count Robert of Paris, and deals with the First Crusade of the eleventh century. The scene is laid chiefly in and around the wonderful city of Constantinople.

We must always bear in mind, when we are thinking about the Waverley Novels, that though most of them are founded upon fact, they do not derive their chief interest from being historical. They are told with so much spirit and romantic force that we are enthralled by the swift and straightforward movement of the story, and never stop to ask ourselves whether it is all true history or largely the invention of the wizard story-teller.

In taking a rapid general view of the Waverley Novels we shall think of them, not in the order in which they were written, but rather in what might be called their historical order. That is, we shall arrange them as though they were all chapters in one long tale covering seven hundred years of the history of Great Britain.

Count Robert of Paris, as we have already heard, is a tale of the First Crusade, of the year 1098. The story itself, or rather what is called the "plot," is not very remarkable. But the adventures of the count and the other leaders of the Crusade, among whom was the famous Peter the Hermit, are full of healthy excitement, and give us a fine picture of those distant times when men lived only to fight. Most of the Crusaders were even more anxious for the fighting than for the avowed object of the Crusade, which was the delivering of the supposed sepulchre of Christ from the hands of the Mohammedans.

The next novel in point of time is The Betrothed, the scene of which is laid chiefly in Wales about the year 1187. This was the time of the Third Crusade, and indeed the novel was written as one of the Tales of the Crusaders. Its interest, however, centres in Wales, the heroine being Eveline, the daughter of Sir Raymond, a Norman lord. She was "the betrothed," and undertook to wait three long years to become the wife of Sir Hugo de Lacy, who had gone away to fight with the Crusaders. But before he could return, Eveline was captured by a Welsh prince, who had previously sought to marry her but had been defeated by Sir Hugo when attacking Sir Raymond's castle. Sir Hugo's

nephew, Sir Damian, rescued her, and was almost killed himself. Eveline nursed him, and they fell in love with each other. When Sir Hugo returned from the Crusade and found that his nephew loved his own bethrothed he generously stood aside and allowed them to marry.

HEROES AND HEROINES OF THE TALISMAN AND IVANHOE

The Talisman, which is one of the finest of Sir Walter's stories, deals with the same period of history and with the battles of the Crusaders in Assyria in the year 1191. The great hero of the story is Richard I, or Richard the Lion-Heart, and his noble enemy is the Sultan Saladin. The "talisman" was just a little red purse which Saladin carried in his bosom, and which, when he came disguised as a physician into the camp of the English king, he used to cure Richard of a fever. There is, of course, a love story in the book as well, and endless adventures. The heroine, the Lady Edith, a kinswoman of Richard, married Sir Kenneth, the heir to the Scottish throne, and Saladin presented her with his talisman.

Ivanhoe is a splendid romance of life in England, just three years later than the period of the previous novel. This is one of the books all boys and girls should read.

Next comes Castle Dangerous, which is a romance of The Perilous Castle of Douglas, so called because it was three times taken from the English during 1306 and 1307. This story was the last that the great novelist wrote. At the time he was broken in health and fortune, and had not many more months to live.

THE STORIES OF THE FAIR MAID OF PERTH AND THE BLACK MONK

The Fair Maid of Perth takes us nearly another century onward in history. The period is 1402, though a descendant of the Douglas has an important part to play in the story. Henry IV now ruled in England, and Robert III in Scotland. There are two love stories in the book. The one that interests us most is, of course, that of the "Fair Maid," whose name is Catharine Glover.

On St. Valentine's Day Catharine kissed Henry Smith, the armorer, while he was asleep. Afterward he proposed to marry her, but she refused. In the end, however, and after many adventures, when Henry might have a knighthood if he cared to accept it, the Fair Maid became the wife of the armorer.

Those were the days when many Scotsmen went abroad to fight for foreign kings and princes in the wars which were always raging on the Continent. Quentin Durward, which is one of the best of the novels, is the tale of a young Scotsman who found his fortune as one of the Scottish guards of Louis XI of France, and ended by marrying a countess in the year 1468.

Just six years later is the period described in Anne of Geierstein, in the scenes of which we travel to Switzerland, Germany and France. We learn much about the secret Tribunal of Westphalia, presided over by the "Black Monk," the father of Anne. Two English gentlemen, the Earl of Oxford and his son, Sir Arthur de Vere, were traveling, disguised as merchants, bearing a letter to the Duke of Burgundy. It would have gone ill with them had it not happened that Anne had met Sir Arthur before and fallen in love with him. So her father acquitted them, and later on Sir Arthur married Anne.

THREE STORIES OF THE DAYS OF THE GREAT REFORMATION

In the story of The Monastery, set in the year 1550, the scene is laid in Melrose, on the Tweed, the neighborhood which Sir Walter loved so much. The Abbot is also a story of Scotland, in the year 1557. Both of these tales are concerned largely with the Reformation, but neither is so interesting as most of the other novels, though Mary Queen of Scots is splendily described in The Abbot.

Kenilworth is a third story of Reformation times, the period being 1575. It is infinitely more interesting than either of the other two. Nothing could be finer than its animated descriptions of Kenilworth Castle and the fête given there by the Earl of Leicester in honor of Queen Elizabeth, whose character is finely described. Leicester had secretly married Amy, the daughter of Sir Hugh Robsart, but dared not let this be known to the queen. Amy's end was mysterious. The story is full of exciting incidents and characters so well described that we seem to have seen them in real life, and are never likely to forget them.

We arrive at the beginning of the seventeenth century, during the reign of King James I, in The Fortunes of Nigel.

It tells the extraordinary adventures of a young Scottish nobleman who went to London to get the king to restore his estates, and was successful, after many disappointments, in establishing his "fortunes."

In A Legend of Montrose we have passed over forty years, and find ourselves in Scotland during that terrible time when the Civil War was raging in England. The Earl of Montrose was fighting for King Charles in the North against the Covenanters, who were led by the Marquis of Argyll. This story contains one of the novelist's finest characters in the person of Sir Dugald Dalgetty.

IN THE DAYS OF THE MERRY MONARCH AND THE GAY CAVALIERS

King Charles I had been beheaded, and the Commonwealth had been declared by the year 1652, with which Woodstock deals. Though not one of Sir Walter's best works, this is a spirited and entertaining romance. It is concerned chiefly with the adventures of Charles II, ending with the death of Cromwell and the king's entry into London.

Peveril of the Peak carries us forward some twenty years and well into the reign of "the merry monarch," the time being 1678. It is a story of Cavalier and Roundhead, telling how the daughter of Major Bridgenorth, who had been a supporter of the Commonwealth, fell in love with Julian Peveril, a Cavalier, and was married to him. It is a very long story, and contains the enormous number of one hundred and eight characters. The Peak is another name for Derbyshire, in which many of the incidents happen.

THE MOST TRAGIC OF SIR WALTER SCOTT'S STORIES

The time of Old Mortality is the same as that of the previous story, but the scene is changed to Scotland and Holland. The Bride of Lammermoor, perhaps the greatest, and certainly the most tragic, of all the Waverley Novels, comes next in point of time. It tells of the sad fate that befell Lucy Ashton because she yielded to the pressure of her parents and married Hayston of Bucklaw, while her true lover, the last Lord of Ravenswood, was hastening home to her from the wars in the Netherlands.

The Pirate gives us a truly romantic picture of the wild scenery and the primitive life of the Shetland Islands at the beginning of the eighteenth century. The Black Dwarf is a romance of about the same period, the scene being laid in the Lowlands of Scotland. "The Black Dwarf" is a mysterious person consulted by Isabella Vere, the daughter of a Jacobite leader, who would force her to marry his friend Sir Frederick Langley. The Black Dwarf helped her, for he was really Sir Edward Mauley, and had power over the unscrupulous Sir Frederick. He appeared just as the wedding was about to take place and forbade it. Isabella later married her own true love, the young squire Earnscliff.

STIRRING STORIES OF THE WILD SCOTTISH HIGHLANDS

Rob Roy, the splendid story of a Highland chief, brings us to the year 1715. Later on you may read more fully of this story as well as of Waverley, both of which refer again to the first half of the eighteenth century. Next comes Redgauntlet, the story of a conspiracy formed by Sir Edward Hugh Redgauntlet in the year 1763 on behalf of the Young Pretender. Guy Mannering, which introduces us to many memorable characters, though the hero himself is not one of these, brings us to the second half of the eighteenth century. With this period the story of The Surgeon's Daughter is also concerned. This describes the remarkable adventures of Menie Gray in India, and her return to her native country.

The stirring romance of The Antiquary deals with the closing years of the eighteenth century. Last of all there is St. Ronan's Well, which brings us into the earlier years of the nineteenth century. This is not a very successful work compared with some of the other fine stories among the Waverley Novels.

THE STORY OF A HIGHLAND REBELLION

THE ROMANCE OF WAVERLEY

THE Second Jacobite Rebellion was almost confined to the Scottish Highlands. It broke out upon the landing on Scottish soil of Charles Edward Stewart, grandson of James II, of England. By his adherents he was called the "Young Chevalier" and "Bonnie Prince Charlie"; but by the other party, "the Young Pre-

tender." It was the object of the rising to place this young man on the English throne, which was then occupied by George II.

THE YOUNG DAYS OF THE HERO, EDWARD WAVERLEY

Edward Waverley, the hero of Scott's first novel, was the son of Richard Waverley, an ambitious politician who looked to the Whigs, the supporters of the king, for political advancement. He was a nephew and heir of Sir Everard Waverley, of Waverley-Honour, a wealthy bachelor.

Sir Everard had no particular love for the House of Hanover, to which King George belonged. As Edward lived partly with his father, and partly with his uncle—his mother being dead—he came in his early years under the influences of the two great opposing political forces of the time.

Sir Everard and his sister, Mistress Rachel, became somewhat alarmed at their nephew's habits of desultory reading and love of solitude, which his father did nothing to counteract. Mistress Rachel suggested that the boy should travel on the Continent with his tutor.

YOUNG CAPTAIN WAVERLEY'S FATEFUL MISSION TO THE HIGHLANDS

Richard Waverley saw no objection to this plan. But Richard's political friends thought otherwise. The result was that the lad was offered, and accepted, a captaincy in a dragoon regiment, then quartered at Dundee. Thither he set forth, carrying, among other things, a fateful letter of introduction from his uncle to the Baron of Bradwardine at his Perthshire seat of Tully-Veolan, on the borders of the Highlands. The baron was an old friend of Sir Everard's and had borne arms on behalf of the Stuarts.

After being initiated into his military duties at Dundee, young Waverley gained leave of absence for a few weeks. He desired to see the country, but his first object was to visit his uncle's friend at Tully-Veolan, a typical old Scottish manor house. Here he received a cordial welcome from the baron and his daughter Rose, a sweet girl of about Waverley's own age. Her hair was a pale gold shade, and her skin like the snow of her own mountains in whiteness. "Yet she had not a pallid or pensive cast of countenance; her features, as well as her temper, had a lively expression; her complexion, though not florid, was so pure as to seem transparent, and the slightest emotion sent her whole blood at once to her face and neck. Her form, though under the common size, was remarkably elegant, and her motions were light, easy, and unembarrassed."

It fell to the lot of Rose Bradwardine to perform the duties of hostess and guide combined. Thus the two were constantly in each other's company.

THE ENGLISH GENTLEMAN AND THE HIGHLAND LASS

She rode with him in the vicinity of Tully-Veolan, and listened with delight as he talked of the books he knew and loved. But while those who saw them together so frequently bethought them that the baron was arranging a match between his daughter and the wealthy young Englishman, Rose's father shut his eyes to possibilities in this direction.

If he had thought of an alliance, Edward's indifference would have offered a bar to the project. His mind was still full of the influence of the old romances he had read in the library at Waverley-Honour. His imagination still led him into mental adventures in which female forms of exquisite grace and beauty mingled. Rose Bradwardine, beautiful and amiable though she was, had not precisely the sort of merit or beauty which captivates a romantic imagination in early youth. She was too frank, too confiding, too kind.

"Was it possible to bow, to tremble, and to adore before the timid yet playful little girl, who now asked Edward to mend her pen, now to construe a stanza in Tasso, and now to spell a very, very long word in his version of it?" No; but, for all that, time at Tully-Veolan passed so agreeably that Waverley applied for and obtained an extension of his leave of absence. The permission was accompanied by a hint from his commanding officer, Colonel Gardiner, to the effect that he should not spend too much of his leisure in the company of those who, estimable as they might be in a general sense, were not supposed to be friendly to the Government or the king, to whose service he had been sworn.

About this time it happened that Tully-Veolan was raided by one Donald Bean Lean, a Highland cateran, or robber, who carried off the baron's milch cows. Raids of this kind were of frequent occurrence

on the Highland border, and a local chieftain, Fergus MacIvor, Vich Ian Vohr, received from many Lowland gentlemen what was known as "protection money," as a surety against the attention of these robbers. Between this chieftain and the baron there had been a quarrel. Rose's father suddenly discovered that he had unknowingly, through an agent, paid "protection money" to Vich Ian Vohr. Thereupon he had promptly stopped the payment.

HOW WAVERLEY CAME TO THE HAUNT OF THE HIGHLAND ROBBER

But after Donald Bean Lean's escapade, Vich Ian Vohr, who held the baron in great respect, sent to the master of Tully-Veolan, offering aid in the recovery of the missing cattle. This message was brought to Tully-Veolan by a kinsman of the chief's, Evan Dhu MacCombich. From the last-named, Waverley heard accounts of Highland ways and customs that stirred his love of adventure. When, therefore, Evan Dhu offered to conduct him to the stronghold of Donald Bean Lean and the home of Vich Ian Vohr, he decided to accept the invitation.

Waverley's journey in the company of Evan Dhu and the latter's wild-looking companions, through wild mountain scenery, was one well calculated to appeal to his love of the romantic. Particularly was he fascinated by that part of the expedition which took him at nighttime in silence over the waters of an unknown lake to the robber's fastness.

On meeting Donald Bean Lean, Waverley was astonished, even alarmed, to find a person of this description so accurately informed of the strength and composition of the various garrisons and regiments quartered north of the Tay. His feelings were further played upon by the robber's mysterious language. Donald Bean Lean spoke as if Waverley had a secret message for him, and regarded it as a grievance that he was not thought worthy of confidence equally with the Baron of Bradwardine and Vich Ian Vohr.

AMONG THE FOLLOWERS OF "BONNIE PRINCE CHARLIE"

The meaning of all this Waverley was not to learn until later. Meanwhile he was hospitably entertained, and the only disconcerting incident was the disappearance of his seal. This was taken from him while he slept. The outlaw used it as a sign of his authority to the recruits Waverley had taken with him to Dundee from Waverley-Honour. These men Donald Bean Lean urged to desert and to join the forces of Charles Edward, "Bonnie Prince Charlie," whenever they heard of the landing of this personage in Scotland.

After his visit to the secret hold of Donald Bean Lean, Waverley was escorted to Glennaquoich, the home of Vich Ian Vohr. He was received very cordially by this chieftain and his sister Flora. Flora MacIvor bore a striking resemblance to her brother. She had the same antique and regular correctness of profile, the same dark eyes, eyelashes and eyebrows, the same clearness of complexion. But the haughty and somewhat stern regularity of Fergus's features was beautifully softened in those of Flora. Her voice was soft and sweet, yet in urging any favorite topic it possessed the tones which impress awe and conviction.

THE CHARMING HEROINE WHO STOOD FAST FOR THE JACOBITES

Flora MacIvor was most devotedly attached to the exiled Stewarts. To contribute to the restoration of their family to the throne, "she was prepared to do all, to suffer all, to sacrifice all." And Flora was as accomplished as she was beautiful.

At first there was nothing at Glennaquoich to tempt Waverley to take up the cause which Vich Ian Vohr and his sister had at heart. That is to say, he was not directly asked to throw in his lot with the cause. But one day he took part in a hunting expedition. This was organized as a kind of prelude to definite action by the Jacobites. Waverley met with an accident which delayed his return to Dundee. But Donald Bean Lean had gone there. While Waverley was at Glennaquoich, the Jacobite was tempting the men of his regiment to join him, and intercepting letters sent to Waverley by Colonel Gardiner, first of all advising, and then commanding, his return to duty.

HOW AN ENGLISH SOLDIER JOINED THE SCOTTISH REBELS

At last dispatches reached Waverley. They contained matters of very deep interest. His father wrote complaining bitterly of bad treatment at the hands of the Government. There was a long-delayed letter from Colonel Gardiner commanding his return to Dundee within three days. Then his uncle and aunt

wrote asking him to resign his commission rather than render himself subject to such treatment as that which had been meted out to his father. From a newspaper put into his hands by Vich Ian Vohr, Waverley next learned that he had been deprived of his commission.

Regarding himself now as a man greatly wronged, one who had been publicly disgraced without a hearing, Waverley threw in his lot with the Highlanders. By this time Vich Ian Vohr had observed, with no little satisfaction, the growing attachment of Waverley to Flora. He saw, indeed, no bar to their union save the relations between Waverley's father and the Government, and his guest's commission in the king's army. These obstacles were now removed.

WAVERLEY MEETS THE PRETENDER TO THE BRITISH THRONE

On her part, if she entertained any feeling other than friendship for Waverley, Flora MacIvor did not show it. And, strongly attached as she was to the cause of the Stewarts, she appreciated the risk involved by the rebels. She bade Waverley consult his reason—not his resentment nor his feelings in regard to herself—before he decided to join them. But the resentment, or the feelings, or both, gained the day.

Thus, it happened that Waverley was introduced by Vich Ian Vohr to the Young Chevalier. And the personal charm of this unfortunate young man completed his conversion. This historic meeting we give in Scott's own words.

BONNIE PRINCE CHARLIE

As they approached the metropolis of Scotland, through a champaign and cultivated country, the sounds of war began to be heard. The distant, yet distinct report of heavy cannon, fired at intervals, apprized Waverley that the work of destruction was going forward. Even Balmawhapple seemed moved to take some precautions, by sending an advanced party in front of his troop, keeping the main body in tolerable order, and moving steadily forward.

Marching in this manner they speedily reached an eminence, from which they could view Edinburgh stretching along the ridgy hill which slopes eastward from the Castle. The latter, being in a state of siege, or rather of blockade, by the northern insurgents, who had already occupied the town for two or three days, fired at intervals upon such parties of Highlanders as exposed themselves, either on the main street, or elsewhere in the vicinity of the fortress. The morning being calm and fair, the effect of this dropping fire was to invest the Castle in wreaths of smoke, the edges of which dissipated slowly in the air, while the central veil was darkened ever and anon by fresh clouds poured forth from the battlements; the whole giving, by the partial concealment, an appearance of grandeur and gloom, rendered more terrific when Waverley reflected on the cause by which it was produced, and that each explosion might ring some brave man's knell.

Ere they approached the city, the partial cannonade had wholly ceased. Balmawhapple, however, having in his recollection the unfriendly greeting which his troop had received from the battery at Stirling, had apparently no wish to attempt the forbearance of the artillery of the Castle. He therefore left the direct road, and sweeping considerably to the southward, so as to keep out of the range of the cannon, approached the ancient palace of Holyrood, without having entered the walls of the city. He then drew up his men in front of that venerable pile, and delivered Waverley to the custody of a guard of Highlanders, whose officer conducted him into the interior of the building.

A long, low, and ill-proportioned gallery, hung with pictures, affirmed to be the portraits of kings, who, if they ever flourished at all, lived several hundred years before the invention of painting in oil colours, served as a sort of guard chamber, or vestibule, to the apartments which the adventurous Charles Edward now occupied in the palace of his ancestors. Officers, both in the Highland and Lowland garb, passed and repassed in haste, or loitered in the hall, as if waiting for orders. Secretaries were engaged in making out passes, musters, and returns. All seemed busy, and earnestly intent upon something of importance; but Waverley was suffered to remain seated in the recess of a window unnoticed by any one, in anxious reflection upon the crisis of his fate.

While he was deep sunk in his reverie, the rustle of tartans was heard behind him, a friendly arm clasped his shoulders, and a friendly voice exclaimed,

"Said the Highland prophet sooth? Or must second-sight go for nothing?"

Waverley turned, and was warmly embraced by Fergus MacIvor. "A thousand welcomes to Holyrood, once more possessed by her legitimate sovereign! Did I not say we should prosper, and that you would fall into the hands of the Philistines if you parted from us?"

"Dear Fergus!" said Waverley, eagerly returning his greeting. "It is long since I have heard a friend's voice. Where is Flora?"

"Safe, and a triumphant spectator of our success."

"In this place?" said Waverley.

"Ay, in this city at least," answered his friend, "and you shall see her; but first you must meet a friend whom you little think of, who has been frequent in his inquiries after you."

Thus saying, he dragged Waverley by the arm out of the guard chamber, and, ere he knew where he was conducted, Edward found himself in a presence room, fitted up with some attempt at royal state.

A young man, wearing his own fair hair, distinguished by the dignity of his mien and the noble expression of his well-formed and regular features, advanced out of a circle of military gentlemen and Highland chiefs, by whom he was surrounded. In his easy and graceful manners Waverley afterwards thought he could have discovered his high birth and rank, although the star on his breast, and the embroidered garter at his knee, had not appeared at its indications.

"Let me present to your Royal Highness," said Fergus, bowing profoundly—

"The descendant of one of the most ancient and loyal families in England," said the young Chevalier, interrupting him. "I beg your pardon for interrupting you, my dear MacIvor; but no master of ceremonies is necessary to present a Waverley to a Stewart."

Thus saying, he extended his hand to Edward with the utmost courtesy, who could not, had he desired it, have avoided rendering him the homage which seemed due to his rank, and was certainly the right of his birth. "I am sorry to understand, Mr. Waverley, that, owing to circumstances which have been as yet but ill explained, you have suffered some restraint among my followers in Perthshire, and on your march here; but we are in such a situation that we hardly know our friends, and I am even at this moment uncertain whether I can have the pleasure of considering Mr. Waverley as among mine."

He then paused for an instant; but before Edward could adjust a suitable reply, or even arrange his ideas as to its purport, the Prince took out a paper, and then proceeded:—"I should indeed have no doubts upon this subject, if I could trust to this proclamation, set forth by the friends of the Elector of Hanover, in which they rank Mr. Waverley among the nobility and gentry who are menaced with the pains of high-treason for loyalty to their legitimate sovereign. But I desire to gain no adherents save from affection and conviction; and if Mr. Waverley inclines to prosecute his journey to the south, or to join the forces of the Elector, he shall have my passport and free permission to do so; and I can only regret, that my present power will not extend to protect him against the probable consequences of such a measure.—But," continued Charles Edward, after another short pause, "if Mr. Waverley should, like his ancestor, Sir Nigel, determine to embrace a cause which has little to recommend it but its justice, and follow a prince who throws himself upon the affections of his people to recover the throne of his ancestors, or perish in the attempt, I can only say, that among these nobles and gentlemen he will find worthy associates in a gallant enterprise, and will follow a master who may be unfortunate, but, I trust, will never be ungrateful."

The politic Chieftain of the race of Ivor knew his advantage in introducing Waverley to this personal interview with the royal Adventurer. Unaccustomed to the address and manners of a polished court, in which Charles was eminently skillful, his words and his kindness penetrated the heart of our hero, and easily outweighed all prudential motives. To be thus personally solicited for assistance by a Prince, whose form and manners, as well as the spirit which he displayed in this singular enterprise, answered his ideas as a hero of romance; to be courted by him in the ancient halls of his paternal palace, recovered by the sword which he was already bending towards other conquests,

gave Edward, in his own eyes, the dignity and importance which he had ceased to consider as his attributes. Rejected, slandered, and threatened upon the one side, he was irresistibly attracted to the cause which the prejudices of education, and the political principles of his family, had already recommended as the most just. These thoughts rushed through his mind like a torrent, sweeping before them every consideration of an opposite tendency,—the time, besides, admitted of no deliberation,—and Waverley, kneeling to Charles Edward, devoted his heart and sword to the vindication of his rights!

The Prince (for, although unfortunate in the faults and follies of his forefathers, we shall here, and elsewhere, give him the title due to his birth) raised Waverley from the ground, and embraced him with an expression of thanks too warm not to be genuine. He also thanked Fergus MacIvor repeatedly for having brought him such an adherent, and presented Waverley to the various noblemen, chieftains, and officers who were about his person, as a young gentleman of the highest hopes and prospects, in whose bold and enthusiastic avowal of his cause they might see an evidence of the sentiments of the English families of rank at this important crisis. Indeed, this was a point much doubted among the adherents of the house of Stewart; and as a well-founded disbelief in the co-operation of the English Jacobites kept many Scottish men of rank from his standard, and diminished the courage of those who had joined it, nothing could be more seasonable for the Chevalier than the open declaration in his favour of the representative of the house of Waverley-Honour, so long known as cavaliers and royalists. This Fergus had foreseen from the beginning. He really loved Waverley, because their feelings and projects never thwarted each other; he hoped to see him united with Flora, and he rejoiced that they were effectually engaged in the same cause. But, as we before hinted, he also exulted as a politician in beholding secured to his party a partisan of such consequence; and he was far from being insensible to the personal importance which he himself gained with the Prince, from having so materially assisted in making the acquisition.

Charles Edward, on his part, seemed eager to show his attendants the value which he attached to his new adherent, by entering immediately, as in confidence, upon the circumstances of his situation. "You have been secluded so much from intelligence, Mr. Waverley, from causes of which I am but indistinctly informed, that I presume you are even yet unacquainted with the important particulars of my present situation. You have, however, heard of my landing in the remote district of Moidart, with only seven attendants, and of the numerous chiefs and clans whose loyal enthusiasm at once placed a solitary adventurer at the head of a gallant army. You must also, I think, have learned, that the commander-in-chief of the Hanoverian Elector, Sir John Cope, marched into the Highlands at the head of a numerous and well-appointed military force, with the intention of giving us battle, but that his courage failed him when we were within three hours' march of each other, so that he fairly gave us the slip, and marched northward to Aberdeen, leaving the Low Country open and undefended. Not to lose so favourable an opportunity, I marched on to this metropolis, driving before me two regiments of horse, Gardiner's and Hamilton's, who had threatened to cut to pieces every Highlander that should venture to pass Stirling; and while discussions were carrying forward among the magistracy and citizens of Edinburgh, whether they should defend themselves or surrender, my good friend Lochiel (laying his hand on the shoulder of that gallant and accomplished chieftain) saved them the trouble of farther deliberation, by entering the gates with five hundred Camerons. Thus far, therefore, we have done well; but, in the meanwhile, this doughty general's nerves being braced by the keen air of Aberdeen, he has taken shipping for Dunbar, and I have just received certain information that he landed there yesterday. His purpose must unquestionably be, to march towards us to recover possession of the capital. Now there are two opinions in my council of war: one, that being inferior probably in numbers, and certainly in discipline and military appointments, not to mention our total want of artillery, and the weakness of our cavalry, it will be safest to fall back towards the mountains, and there protract the war until fresh succours arrive from France, and the whole body of the Highland clans

shall have taken arms in our favour. The opposite opinion maintains, that a retrograde movement, in our circumstances, is certain to throw utter discredit on our arms and undertaking; and, far from gaining us new partisans, will be the means of disheartening those who have joined our standard. The officers who use these last arguments, among whom is your friend Fergus MacIvor, maintain, that if the Highlanders are strangers to the usual military discipline of Europe, the soldiers whom they are to encounter are no less strangers to their peculiar and formidable mode of attack; that the attachment and courage of the chiefs and gentlemen are not to be doubted; and that as they will be in the midst of the enemy, their clansmen will as surely follow them; in fine, that having drawn the sword we should throw away the scabbard, and trust our cause to battle and to the God of Battles. Will Mr. Waverley favour us with his opinion in these arduous circumstances?"

Waverley coloured high betwixt pleasure and modesty at the distinction implied in this question, and answered, with equal spirit and readiness, that he could not venture to offer an opinion as derived from military skill, but that the counsel would be far the most acceptable to him which should first afford him an opportunity to evince his zeal in his Royal Highness's service.

"Spoken like a Waverley!" answered Charles Edward; "and that you may hold a rank in some degree corresponding to your name, allow me, instead of the captain's commission which you have lost, to offer you the brevet rank of major in my service, with the advantage of acting as one of my aides-de-camp until you can be attached to a regiment, of which I hope several will be speedily embodied."

"Your Royal Highness will forgive me," answered Waverley, (for his recollection turned to Balmawhapple and his scanty troop,) "if I decline accepting any rank until the time and place where I may have interest enough to raise a sufficient body of men to make my command useful to your Royal Highness's service. In the meanwhile, I hope for your permission to serve as a volunteer under my friend Fergus MacIvor."

"At least," said the Prince, who was obviously pleased with this proposal, "allow me the pleasure of arming you after the Highland fashion." With these words, he unbuckled the broadsword which he wore, the belt of which was plated with silver, and the steel basket-hilt richly and curiously inlaid. "The blade," said the Prince, "is a genuine Andrea Ferrara; it has been a sort of heir-loom in our family; but I am convinced I put it into better hands than my own, and will add to it pistols of the same workmanship.—Colonel MacIvor, you must have much to say to your friend; I will detain you no longer from your private conversation; but remember, we expect you both to attend us in the evening. It may be perhaps the last night we may enjoy in these halls, and as we go to the field with a clear conscience, we will spend the eve of battle merrily."

Thus licensed, the Chief and Waverley left the presence-chamber.

"How do you like him?" was Fergus's first question, as they descended the large stone staircase.

"A prince to live and die under," was Waverley's enthusiastic answer.

"I knew you would think so when you saw him, and I intended you should have met earlier, but was prevented by your sprain. And yet he has his foibles, or rather he has difficult cards to play, and his Irish officers, who are much about him, are but sorry advisers,—they cannot discriminate among the numerous pretensions that are set up. Would you think it—I have been obliged for the present to suppress an earl's patent, granted for services rendered ten years ago, for fear of exciting the jealousy, forsooth, of C—— and M——. But you were very right, Edward, to refuse the situation of aide-de-camp. There are two vacant, indeed, but Clanronald and Lochiel, and almost all of us, have requested one for young Aberchallader, and the Lowlanders and the Irish party are equally desirous to have the other for the Master of F——. Now, if either of these candidates were to be superseded in your favour, you would make enemies. And then I am surprised that the Prince should have offered you a majority, when he knows very well that nothing short of lieutenant-colonel will satisfy others, who cannot bring one hundred and fifty men to the field. 'But patience, cousin, and shuffle the cards!' It is all very well for the present, and we must have you properly equipped for the evening in your new costume; for, to say

truth, your outward man is scarce fit for a court."

"Why," said Waverley, looking at his soiled dress, "my shooting jacket has seen service since we parted; but that, probably, you, my friend, know as well or better than I."

"You do my second-sight too much honour," said Fergus. "We were so busy, first with the scheme of giving battle to Cope, and afterwards with our operations in the Lowlands, that I could only give general directions to such of our people as were left in Perthshire to respect and protect you, should you come in their way. But let me hear the full story of your adventures, for they have reached us in a very partial and mutilated manner."

Waverley then detailed at length the circumstances with which the reader is already acquainted, to which Fergus listened with great attention. By this time they had reached the door of his quarters, which he had taken up in a small paved court, retiring from the street called the Canongate, at the house of a buxom widow of forty, who seemed to smile very graciously upon the handsome young Chief, she being a person with whom good looks and good-humour were sure to secure an interest, whatever might be the party's political opinions. Here Callum Beg received them with a smile of recognition. "Callum," said the Chief, "call Shemus an Snachad (James of the Needle)." This was the heredity tailor of Vich Ian Vohr. "Shemus, Mr. Waverley is to wear the *cath dath* (battle colour, or tartan); his trews must be ready in four hours. You know the measure of a well-made man: two double nails to the small of the leg—"

"Eleven from haunch to heel, seven round the waist—I give your honour leave to hang Shemus, if there's a pair of sheers in the Highlands that has a baulder sneck than her's ain at the *cumadh an truais* (shape of the trews)."

"Get a plaid of MacIvor tartan, and sash," continued the Chieftain, "and a blue bonnet of the Prince's pattern at Mr. Mouat's in the Crames. My short green coat, with silver lace and silver buttons, will fit him exactly, and I have never worn it. Tell Ensign MacCombich to pick out a handsome target from among mine. The Prince has given Mr. Waverley broadsword and pistols, I will furnish him with a dirk and purse; add but a pair of low-heeled shoes, and then, my dear Edward, (turning to him,) you will be a complete son of Ivor."

. . . .

To continue the tale in our summarized form we find that Flora, ignorant of her own brother's attachment to the baron's daughter, used her influence to make Waverley think more intimately of her friend, Rose Bradwardine. Between love and war Waverley was carried almost breathlessly along in the train of the rebellion. He took part in the victory of the Highlanders at Preston-Pans, and in this battle saved the life of his uncle's friend, Colonel Talbot.

There was another incident of the battle which made a grave impression on Waverley's mind. This was the death of Colonel Gardiner. The colonel, sorely wounded, was maintaining a desperate and unavailing resistance against the Highlanders when Waverley saw him.

"To save this good and brave man became the instant object of his most anxious exertions. But he could only witness his fall. Ere Edward could make his way among the Highlanders, who, furious and eager for spoil, now thronged upon each other, he saw his former commander brought from his horse by the blow of a scythe, and beheld him receive, while on the ground, more wounds than would have let out twenty lives."

After the battle of Preston-Pans, Waverley marched with the rebels into England. He was with them in their enforced return, till the disaster at Clifton, where Vich Ian Vohr was taken prisoner. Then he was separated from them. Unflinchingly loyal to the cause he had espoused, Vich Ian Vohr met his death within the grim walls of Carlisle Castle. Broken at last in spirit, Flora MacIvor, lamenting that she had urged her brother on to his terrible end, sought refuge in the convent of the Scottish Benedictine nuns in Paris. Waverley was pardoned, and his life was saved largely through the affectionate devotion of Rose Bradwardine. Her kindness to the outlaw's daughter was the means of bringing to light Donald Bean Lean's treacherous use of Waverley's letters.

A wiser and an infinitely stronger man for his adventures, Waverley married Rose Bradwardine, and became master of Waverley-Honour.

THE NEXT STORY OF FAMOUS BOOKS IS ON PAGE 4337.

Stone money used in Yap, one of the Caroline Islands in the north Pacific Ocean.

MONEY AND COIN COLLECTING

A FINE HOBBY FOR BOYS AND GIRLS

COIN collecting, or the study of numismatics, pronounced "nu-mis-mat′-ics," is an educational and often a profitable hobby. This science dates back several thousand years B.C. and in some instances is the only record known of the civilization existing at particular periods.

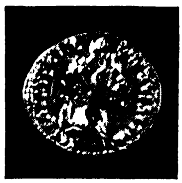
The Chinese had a metallic form of currency as early as 2,000 B.C. but the first silver coin having a definite weight and fineness and therefore a fixed value, was not struck until about 700 B.C. This occurred in Aegina, an island off the coast of Greece, and from that time the world has had the use of coins in carrying on trade and commerce. Just how is one to define a coin? According to a famous authority, when metal is used to make it easier to trade, it becomes currency; when currency is used in accordance with certain weight standards, it becomes money; when money is stamped with a device (or design) it becomes coin.

Through coins the collector often comes in contact with facts bearing upon history, art, religion, economics and customs. One of the most artistic coins ever struck was the dekadrachm of Syracuse, about 400 B.C. Several years later, about 330 B.C., the coins of Macedon were imprinted with the portrait of Alexander the Great, the first time the likeness of a human being had ever appeared on coins. Before it the portraits had represented the various gods. In this way the likenesses of many of the early Greek and Roman kings and rulers have been passed down to the present time. The practice still prevails in countries that have a monarchical form of government.

Many of the financial schemes tried in recent years were used hundreds of years ago. Debasement and depreciation of the currency are not things discovered by the present generation. In other words, through a knowledge of the coins and other money used in various periods one can trace the political and economic disturbances of nations and civilizations.

Have you ever wondered what Julius Caesar, Augustus, Nero, Hadrian and even Cleopatra looked like? If so, coins of these individuals are easily secured and are rich in history and tradition. In addition to collecting Greek and Roman coins of the various kings and emperors, some collectors specialize in the coins of the Bible. Of special mention in this series are the silver shekel of

Israel; the lepton of Judea or "Widow's Mite"—the smallest copper coin of the period; and the denarius of Tiberius Caesar or the "Tribute Penny"—a silver coin about the size of the United States dime. The latter two coins can be obtained at moderate prices.



Left: Spanish milled dollar or "piece of eight" (1787). Right: ***denarius*** **or penny issued in the reign of the Emperor Tiberius (14-37 A.D.)**

In some parts of the world coins are seldom used as a medium of exchange. Instead, the natives use various types of commodities or strings of wampum. Everyone is familiar with the use of wampum in trade between the American Indians and the people of the Colonies, and while that method of exchange long ago ceased to exist in this country it is still an important factor in parts of Africa and the islands in the South Seas.

Among the odd and curious forms of money that have been used in various places are: Rock salt money of Asia and Africa; brick tea money of Mongolia, Tibet and Siberia; bamboo money of China; spear coins of the Congo; copper cross of the Congo, the Baluba's price for a wife; shoe- and boat-shaped silver coins of China; bullet and "pack saddle" coins of Siam; wire money of Arabia; and the stone money of the Island of Yap. A specimen of this stone money weighing 180 pounds is equivalent to 10,000 cocoanuts, one-quarter acre of land, an eighteen-foot canoe or a wife. Specimens of the pieces mentioned above may be seen in the exhibit of Moneys of the World maintained by the Chase National Bank in New York.

One of the largest coins to be struck in metal is the 8 daler copper piece of Sweden weighing 31 pounds which was issued in the seventeenth century. In contrast there is a small gold coin, issued in the eighteenth century in Colpata in Southern India, which weighs one grain and is about the size of a large pin head. Some people specialize in collecting coins of one size and to-day one of the most popular series is the dollar-size.

The American "dollar" is supposed to have originated from a silver coin struck in Joachimsthal, Jacob's Valley, in Bohemia, about 1525. This coin was readily acceptable throughout that area of Europe because of its convenient size and weight, and was called a "thaler." Other coins made in Germany about this same size and weight were called thalers, while in Italy a similar coin was called a "tallero"; in Sweden a "daler"; and translated into English, "dollar."

When the United States began striking its coins, the large coin, first struck in 1794, was called a "dollar." The United States mint was established in 1792 and in that year a quantity of half "dimes" was struck from silver supposedly supplied by George and Martha Washington. These coins were not for general circulation, as the first coins of this type were the one cent pieces in 1793.

"Pieces of Eight" and "Spanish Doubloons"! To practically every American boy and girl these expressions bring to mind the adventurous stories of pirate lure and ill-gotten gains. Do they know that these coins were in actual circulation here in America during the eighteenth century? The doubloon, or 8 escudo piece, was a gold coin struck in the Spanish-American countries and was the equivalent of about $16 in our money. The technical term of the Spanish Milled Dollar or "piece of eight" was 8 reales and from this was derived the expression "two bits." In some localities the people, in order to make small change, would take the 8 reales coin, equal in value to the United States dollar, and cut it into halves and quarters or "bits" equivalent to 4 reales and 2 reales. The 2 reales coin had about the same value as the American 25 cent piece. In some parts of the United States the 25 cent piece is still referred to as "two bits."

THE PINE TREE SHILLING AND THE FUGIO CENT

Other interesting historical coins of this country are the Pine Tree Shilling and the Fugio Cent. The former is a silver coin and was first struck by the Colonists in Massachusetts in 1652. It was struck for about 30 years but always bore the same date. It has a tree on the obverse and on the reverse is the date "1652" and "XII" within a beaded circle.

In 1787 the Fugio Cent, a copper piece, was the first coin to be authorized by the United States Government. Previous to that date several of the States, namely, New Hampshire, Vermont, Connecticut, Massa-

chusetts, and New Jersey, had issued copper cents, but with the striking of coins by the government that practice ceased.

The fugio cent received its name from the word *Fugio*, which is on the coin and to the left of a sun-dial, signifying "Time is flying." Under the dial is the terse saying "Mind your business" which has been interpreted as follows: "You (referring to foreign powers), take care of your affairs and we'll take care of ours." On the other side of the coin 13 small circles linked together represent the 13 states. Inside another circle in the centre is the inscription "We Are One." It has been suggested that the young men of the period presented this coin with the above inscription to the lady of their choice.

COLLECTING COINS AS A HOBBY

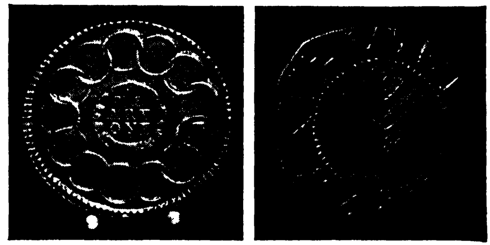
Some of the historical aspects of coin collecting have been discussed, and now comes the question of how to start a collection. It is suggested that one start slowly and possibly acquire types of coins from many geographical places. Then one should endeavor to find out some history pertaining to these coins. In this way a general collection is easily formed, without a large outlay of money, and the experience gained will be helpful in specializing in a particular series.

Many people believe that the hobby of coin collecting, which, in the broad sense, includes medals, decorations, tokens, paper money, and other items that have been used for money, is an expensive pastime. Such is not necessarily the case. It is like most anything else, one can spend a great deal, but you can also have fun by purchasing moderately priced pieces. The numismatist who can identify various coins of minor denominations is apt to get far more out of the subject than one who spends large amounts for rare silver and gold coins, but who knows very little about the pieces. The historical, educational and artistic importance of a coin is the same for an inexpensive piece as for one of a much higher price.

Often an individual starts collecting by having an unusual coin given to him. If his curiosity is aroused he will endeavor to find out all he can about the piece. Then, if he is particularly interested, he will probably obtain other coins and before he knows it he has begun collecting.

Coins may also be obtained by trading duplicates with other collectors and by purchasing them from recognized coin dealers and foreign exchange dealers. Another interesting way to obtain them is to rummage in old antique shops. Many a collector has received a thrill in picking up some insignificant coin in a "junk shop" only to find on closer examination and study that it is a scarce piece. Many happy and profitable hours can be spent in pursuing this hobby.

One thing to keep in mind is that the coins should be obtained in the best possible condition. The value of coins depends on condition as well as upon rarity.



The Fugio Cent and the Massachusetts Pine Tree Shilling.

In the United States there are three outstanding numismatic collections which are open to the public. The National Museum in Washington, D. C., has a representative collection of the world but is strongest on the United States series. Probably the largest coin exhibit in this country, together with the finest numismatic library, is located in the building of the American Numismatic Society in New York City. This exhibit is noted for its Greek and Roman coins, Oriental coins, medals and decorations, and a representative collection of coins from all over the world.

The other noted collection is also located in New York City and is maintained by the Chase National Bank for educational purposes. This exhibit is one of the most comprehensive collections in the world. It not only contains specimens of coins and paper money from practically every geographical division but it also has hundreds of pieces of wampum, commodity, and odd forms of money. Information concerning coins will be gladly given by all of the three institutions mentioned above.

The collector wishing to learn more about this hobby should join the American Numismatic Association. This organization of about 4,000 collectors publishes a monthly magazine, the Numismatist, which is devoted to the subject of coin collecting.

Article by Vernon L. Brown, Curator, Chase National Bank Collection of Moneys of the World.

AN AMUSING HAT TRICK

WE tell our friends we can place a glass of water on the table, cover it with a hat and drink the water without removing the hat. Here is how it is done. We set the glass of water on a table, borrow a hat and place it over the glass. We then get under the table and pretend to drink.

Next, we ask somebody to remove the hat in order to see if the water is still in the glass. As soon as the hat has been lifted up, we seize the glass and drink the water. That is what we promised to do. You see, we drank the water without removing the hat. Somebody else removed it!

GAMES FOR TINY CHILDREN

BIG boys and girls will not want to come with us now, for we are going to have fun with very little people.

HUNT THE SLIPPER

ALL the players but one—"cobblers," as they are called—sit on the floor in a circle a few inches apart. Then the customer comes and says: "Please, I want this old slipper mended. I will call for it in ten minutes."

She hands one of the cobblers an old slipper, and turns away. When she has counted up to ten she comes back, but is told that the slipper is not ready.

"I must have it," says the customer.

"Then you must find it," all the cobblers reply.

At that the search begins. Each cobbler passes the slipper on to his or her neighbor, hiding it from sight as much as possible; but if the seeker should catch sight of the slipper and call out the name of the cobbler who has it, that cobbler must take her place, and bring the slipper to be mended again. The slipper must not stop in one place but must keep passing around in the circle either one way or the other.

FEATHER AND FANS

A FLUFFY feather out of any cushion will do for this game, and if you have no fans, stiff pieces of paper or cardboard will do quite as well. Draw a line across the floor and let half the number of players be on one side and half the number on the other. When all are ready, toss the feather into the air and keep it up in the air with the fans or whatever objects are used as a substitute for the fans. No players must leave their side of the line, but should do their best to stop the feather sailing across it. Those in whose country it falls at last lose the game.

PUSS IN THE CORNER

IN this game all the children pretend to be mice, except one, who is the puss. "Puss" stands in the middle of the room. Each mouse stands in a corner. While they are there Puss cannot touch them, but when they run across the room to change corners with one another, she may capture any she can. No mouse should venture from a corner until she has made signs to another mouse with whom she would like to change houses, or she may find herself halfway across the room with no corner to run to. The mouse who is caught must take the place of Puss.

TUNNELS

THERE should be a good many players for this game. Choose partners; form two lines a little apart, each couple standing one behind another. The front, or leading, couple then forms an arch by joining hands, and the last two of the line skip together down the alley of players, pass under the arch, and stopping immediately on the other side, make a second arch. Then the next two from the end do the same, and the next, and so on, until a long tunnel is formed of lifted hands. The tunnel may be taken down by the first partners who began it lowering their arch and passing through. The next two follow, until the last arch falls and the builders are ready for another game.

HOLD FAST! LET GO!

IN this game you must do just the opposite of what you are told. There are four players. Each takes hold of one corner of a handkerchief. A fifth player calls out: "Hold fast!" and anyone who does not let go will be out. If the order is "Let go!" those who fail to hold fast will be out. The last one out is the winner.

WINKS

A CIRCLE is formed of chairs, only one of which is unoccupied. Behind each chair, including the vacant one, stands a player who tries to prevent the person sitting there from leaving the chair. The guardian of the vacant seat winks to someone to come and occupy it. The player who is called tries to get away from his chair without being touched by his own guardian. If he is successful, the chair which he has left behind becomes the vacant one. The player behind it tries to get another tenant by a wink at someone else.

YOU MUSTN'T LAUGH

ALL sit in a row and look as solemn as possible. Then the first player says: "Ha! Ha!" which is repeated all down the line. The players who cannot do this without laughing are declared out, and they leave their seats. Those remaining in the game repeat the same process. After each round those who have laughed must leave their seats. This is continued until only one is left, and he or she is the winner.

If only two are left and both laugh when saying "Ha! Ha!" they must continue until one of the two can refrain from laughing.

THROWING SHADOWS ON THE WALL

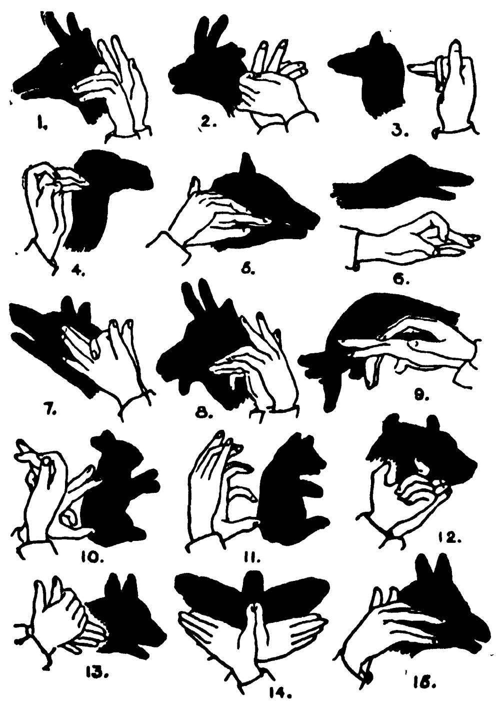
THE study of shadows is a very important branch of science. For example, the various phases of the moon are caused by the shadow of the earth cast upon the moon by the sun. Eclipses, too, are caused by shadows, either of the earth or of the moon.

Shadows help scientists to learn many facts about this universe; they can also provide boys and girls with a great deal of entertainment. By casting shadows on a wall with no other apparatus than our own hands and a good strong light, we can make a great variety of interesting figures of every description. Of course we must be sure to keep our hands between the source of light and the wall or other surface upon which we desire to cast the shadows.

On this page we show a number of shadows of animals that any boy or girl may learn to make with a little practice. We should imitate closely the position of the hands as shown in each picture until we can form the shadow correctly. We should repeat the different forms again and again. After a while we shall remember the position of the hands without having to refer to the picture—an important matter if we wish to give a shadow-casting performance.

When we have succeeded in learning to make the various forms, we must next learn to give action to the shadows by moving the fingers or thumbs so that the animals appear to be eating or moving their ears or their legs. It also adds greatly to the effect if we can imitate the sounds that are made by the different animals—barking, grunting, braying and so on.

The shadows shown in the picture are merely a few of hundreds that may be produced by different combinations of the hands

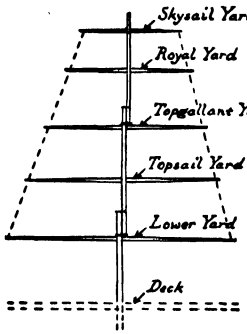


Shadows made by the hands. 1. Reindeer. 2. Chamois. 3. Hound. 4. Camel. 5. Pig. 6. Goose. 7. Wolf. 8. Goat. 9. Elephant. 10. Hare. 11. Bear. 12. Ox. 13. Dog. 14. Butterfly. 15. Donkey.

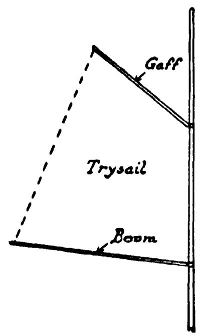
and fingers. We can invent additional forms as we become skilled in making shadows. The same position of the hands (or almost the same position) will give entirely different shadows, provided that the hands are held at different angles to the light and a finger or two is moved this way or that.

HOW TO KNOW SAILING SHIPS

THE stately brigs and barkentines and clippers that once ruled the seven seas have been replaced to a large extent by vessels driven by steam engines or gasoline motors or oil-burning engines. Yet sailing ships have by no means disappeared, and the smaller sailboats are still very popular the world over. Boys and girls who man their own little sailboats will want to be



1. Mast and yards.



2. Boom, trysail and gaff.

able to distinguish between the different kinds of masts and the different kinds of sailing ships that still ride the waves.

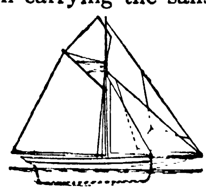
An acquiantance with sailing ships will also prove very valuable to that army of young readers who love stirring tales of the sea. A large part of what they read will be without meaning unless they can distinguish between a trysail and a boom, between a schooner and a brig. This article and the pictures in it have been specially prepared in order that we may learn many things about masts and sails and spars. Once we know about these things, beloved stories like Treasure Island and Two Years Before the Mast will acquire new meaning.

Before we examine the different kinds of ships, we must understand something about masts. A mast is a long pole sticking upright or nearly upright in the sailing ship and made to carry a sail or several sails. The masts, which are very securely fastened to the bottom part of the ship (called the keel) stick up through the deck. Masts are generally made of wood. Sometimes however they are hollow and are made of some metal, like iron or an aluminum alloy. Masts taper somewhat from the bottom to the top. Ropes (in a number of cases a single rope), often of wire, connect the top of the mast with the sides of the deck or connect two masts. These ropes are known as the rigging.

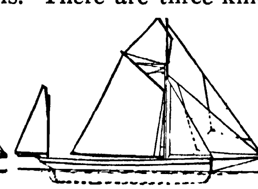
A ship may have one or more masts. If there is only one mast, it is called simply the *mast*. If there are two masts, the front one is called the *foremast* and the second is the *mainmast*. If there are three masts, the third is called the *mizzenmast*. If there is a fourth mast, it is called the *jigger-mast* if it has no yards or spars such as those which are shown in figure 1; it is called the *after-mizzenmast* if it has yards. Masts for comparatively small sailing ships are generally made of one piece. Masts for large ships are made in more than one piece; the various sections are fastened together as illustrated in figure 1.

Every sailing ship has what is called a *bowsprit*. A bowsprit is a spar or stick set in front of the ship in a horizontal or almost horizontal position.

Spars are attached to the masts to assist in carrying the sails. There are three kinds



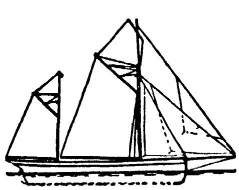
3. Cutter or sloop.



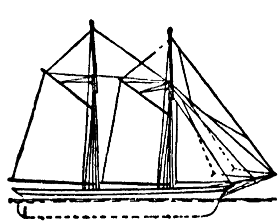
4. Yawl.

of such spars: *yards* (figure 1), *booms* (figure 2) and *gaffs* (figure 2). The yard is a spar that goes across the mast; from it and in front of the mast the sail hangs downward. The length of the yard may be across the ship, or it may be moved around to any angle so that the sail may catch the wind fairly.

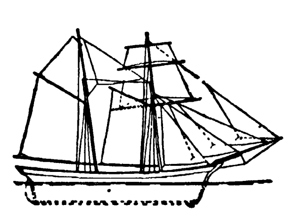
The boom is a horizontal spar. It stretches



5. Ketch.



6. Fore-and-aft schooner.



7. English schooner.

backward from the mast toward the stern or back of the ship. Like the yard the boom may be moved around so that it may catch the wind from any quarter. The gaff is something like a boom. It holds at the top the sail that the boom holds below. The position of the gaff is not horizontal, like that of the boom. The gaff slopes upward from the mast to which it is attached. The sail that is set in position between a boom and a gaff is called a *trysail* (figure 2).

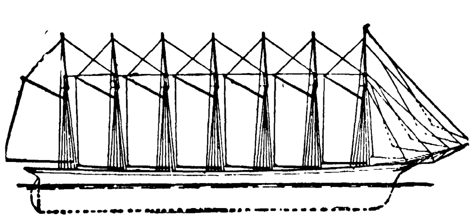
If a ship carries masts that have yards, it is known as a square rigged ship. Ships of this type carry a set of triangular sails, called *jibs*, at the prow or front part of the ship. The jibs are hung on stays (that is, supporting ropes). These are strung from the foremast to a *jibboom* (a horizontal or almost horizontal spar supported by the bowsprit) and also to a *flying jibboom*, extending beyond the jibboom.

Below the jibboom and flying boom and at right angles to them is often set a boom known as a *dolphin striker*. This supports the stays that brace the boom and the flying jibboom from below. A dolphin striker is shown in figure 7. It derives its name from the fact that it is sometimes set so low that the large fish known as the dolphin might almost touch it as it playfully leaped about on the surface of the water.

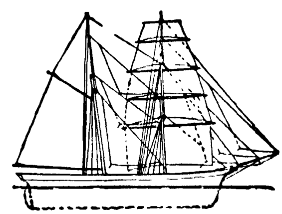
The yards, booms and gaffs are known by the names of the masts to which they are attached. The foreyard is a yard on the foremast, the mainboom is the boom on the mainmast, the mizzengaff is the gaff on the mizzenmast and so on.

A mast may have several yards, as is shown in figure 1. The bottom yard is known as the *lower yard*. It may also be named after the mast on which it is carried. Thus we have the *foreyard*, the *mainyard* and so on. The sail that hangs from this yard is known as the *mainsail*. The yard above the lower yard is known as the *topsail yard*, and this carries the *topsail*. If the topsail is in two parts it is carried on two yards, known as the *lower topsail yard* and the *upper topsail yard* respectively. Above the topsail yard or yards is the *topgallant yard*, bearing the *topgallant sail*. As in the case of the topsail the topgallant sail may be in two parts. If this is the case, these two parts are carried on the *lower topgallant yard* and the *upper topgallant yard*, respectively.

The yard above the topgallant yard is called the *royal yard*, carrying a comparatively small sail, the *royal sail*. If there is still a higher yard, it is known as the *skysail yard*, carrying the skysail.



8. Fore-and-aft seven-masted schooner.

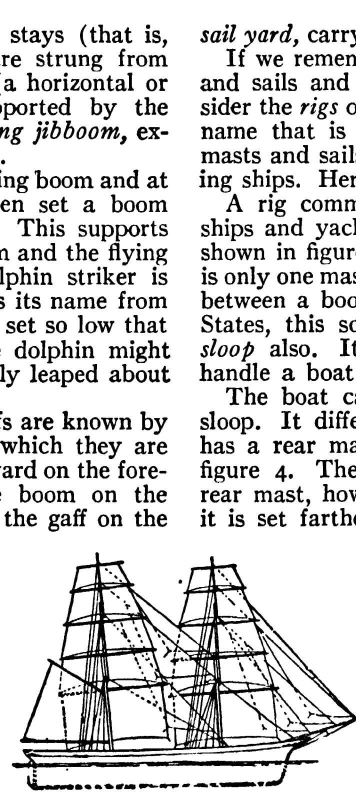


9. Brigantine.

If we remember these points about masts and sails and yards, we are ready to consider the *rigs* of various ships. The rig is the name that is given to the combination of masts and sails on the various types of sailing ships. Here are the principal rigs.

A rig commonly found on small sailing ships and yachts is the *cutter* rig, which is shown in figure 3. In this type of rig, there is only one mast and the mainsail is stretched between a boom and a gaff. In the United States, this sort of boat is often called a *sloop* also. It is comparatively simple to handle a boat of this type.

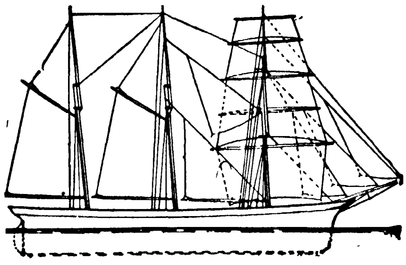
The boat called the *yawl* resembles the sloop. It differs from the sloop in that it has a rear mast at the stern, as shown in figure 4. The *ketch* is like a yawl. The rear mast, however, is generally larger and it is set farther forward in the boat. It is illustrated in figure 5.



10. Brig.

The *rig* of the schooner is among the most popular in sailing vessels to-day. It is often found on the sailing ships that engage in coastwise trade and also in fishing craft. The fore-and-aft schooner rig, which is most common on this side of the Atlantic, has no yardsails but only trysails. Often a

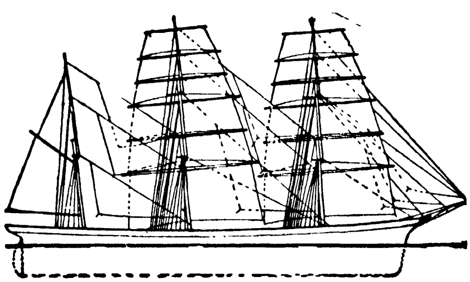
schooner of this type has only two masts, as illustrated in figure 6. In England the ordinary schooner rig (figure 7) has a foremast with a topsail and a topgallant sail,



11. Barkentine.

but a trysail instead of a lower yardsail. On the mainmast there is a trysail and a topsail. A schooner may have more than two masts and still be classed as a schooner. If there are more than two masts the same sort of trysail is used on each. In figure 8 we see a rather extreme type of many-masted schooner, a seven-masted craft.

We come now to the larger sailing ships. The *brigantine,* which is shown in figure 9,

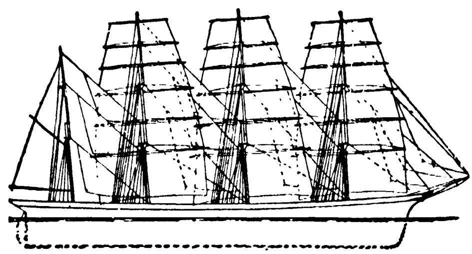


12. Three-masted bark.

has a foremast with yards and a mainmast with a fore-and-aft sail like that of a schooner. The ship known as the *brig* has a foremast that carries yardsails only. The rear or main mast, however, carries not only yardsails but also a trysail. This rig is shown in figure 10. The *barkentine*, which is illustrated in figure 11, has a foremast with yards. It also has a mainmast and a mizzenmast with fore-and-aft sails.

A popular rig for modern sailing ships, particularly those that ply between distant ports, is the *bark*. This type of rig requires not fewer than three masts. The mast nearest the stern has a trysail, but the other masts have yards and yardsails. Figure 12 shows us a three-masted bark and figure 13 a four-masted bark. These are the commonest types of barks. However, in the case of very large ships, barks sometimes have five masts. In this case the front four masts are rigged alike with yardsails and only the fifth mast has a trysail.

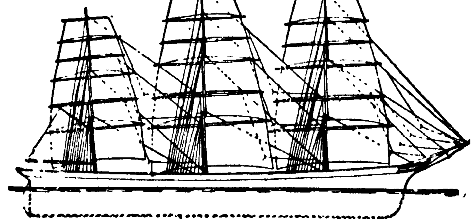
The *full-rigged ship* must have not fewer than three masts and it sometimes has four masts. Comparatively few full-rigged ships with five masts have been built. All the masts in the full-rigged ship have yards and yardsails, and the mast that is nearest the stern has a trysail as well. In figure 14 we show you a full-rigged ship with three masts. Note the added trysail that is set on the mizzenmast.



13. Four-masted bark.

Now that you have learned the names of the principal types of sailing craft you will find it fascinating to try to identify the rig of the sailing ships that you actually see riding the waves or that you find in books or magazines or newspapers.

Of course in a short article like this we have not been able to give you full details about sailing ships and their various parts. It would take many, many pages to provide



14. A Full-rigged ship.

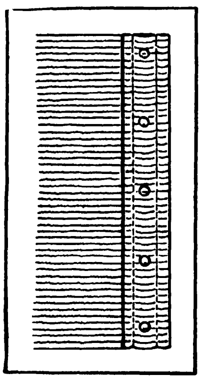
this information. If you are interested in learning still more about sailing vessels, you will find a great deal of interesting material in The Last Days of Mast and Sail by A. H. Moore and Sailing Ship Rigs and Riggings by Harold A. Underhill.

A HAMMOCK FOR A CAMPING OUTFIT

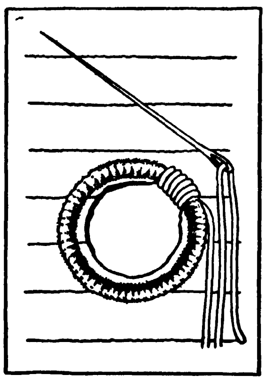
WE are going to tell you how to make a hammock that will be comfortable and durable. You will need the following material: 2½ yards of 8-ounce cotton duck, a spool of linen thread, a piece of beeswax and two small steel or iron rings, about three inches in diameter.

Turn down a 4-inch hem at each end of the length of material. Wax your thread with the beeswax. Turn in the material a good ½ inch and then backstitch with large stitches. An inch and a quarter nearer the end run a second line of backstitching.

Your hammock will now look like a curtain with a hem and rod casing at either end. Smooth out each end in turn and in the



1.

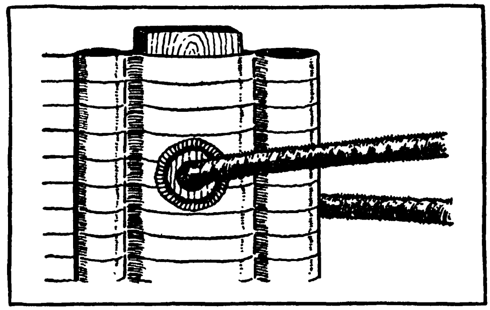


2.

1¼-inch space between the two lines of backstitching draw five circles, each ¾ of an inch in diameter, as shown in figure 1. The outer circles should not be less than 1¼ inches from the edge of the cloth.

Waxing your thread again, stitch once around each ¾-inch circle through the two thicknesses of cloth. Then cut away the material within the circle, but not too near the stitching. Lay a loop of waxed heavy twine or cord around the eyelet that is formed, and over this work as closely as possible with waxed thread (figure 2).

The hammock may now be folded flat and packed with your camping outfit. When you plan to use the hammock, get two strong pieces of wood that will be long enough and narrow enough to fit in the hem at either end. (Barrel staves will serve very well.) When the pieces of wood (called spreaders) are in place, bore five holes in them; these holes are to be bored right through the center of each eyelet. They are to be large

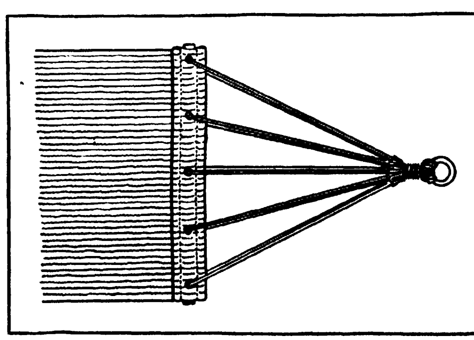


3.

enough so that you will be able to pass a clothesline through them.

Now provide yourself with five six-foot lengths of clothesline; these are to be fitted at one end of the hammock. Each length is to be waxed. One end is inserted through an eyelet from underneath, drawn through the hole in the spreader and then drawn out again through the upper part of the eyelet (figure 3). The double line thus formed is adjusted so that its two parts are equal in length. The other lines are put through the remaining eyelets.

The ends of all five double lines are now gathered together and put through one of the steel or iron rings. Then they are doubled back for six inches from the ring. Finally stout waxed cord is wound round and round the lines, until they are securely in place (figure 4). The process is repeated at the other end of the hammock with five other six-foot lengths of clothesline. Your hammock is now ready to be set in place.



4.

The rings are to be suspended from strong hooks that you may buy in any hardware store for a small amount of money.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 4261.

SCIENCE

ELECTRICITY AND MAGNETISM

IN the olden tales of the ARABIAN NIGHTS, one story is told of a ship which approached an island made of magnetic rocks; the ship fell completely to pieces because all the iron nails were pulled out. Of course such a legend is pure fantasy, but it shows that from earliest times men knew of the remarkable properties of the heavy, black, metallic ore of iron known as magnetite. Bits of magnetite were called lodestones, which means leading stones. We shall soon see why. The Greeks, the Hebrews and the Romans wrote often about the magnetism in pieces of this strange substance, and the ore was highly prized because it had the power of attracting pieces of iron to itself. Any material which has such a power is called a magnet.

A lodestone is called a natural magnet because is it found in nature. Geologists have found large deposits of this magnetic material in various parts of the earth. Most magnets nowadays, however, are not natural; they are artificial, that is, manufactured from steel and made into a bar or horseshoe shape. Man-made magnets can be made many times more powerful than lodestones.

If you have a magnet it will be easy for you to make additional ones. Draw the end of your magnet along a piece of steel. Be sure that you stroke in one direction only. See if you can make your knife-blade a magnet by rubbing it on the end of a horseshoe magnet. The strange thing about making magnets in this way is that no matter how many you make, the original magnet does not lose any of its magnetism.

Try to make a bar of soft iron a magnet by stroking. The soft iron does not become a very good magnet, and it rapidly loses its magnetism. Steel is less easy to magnetize, but makes permanent magnets. Even a permanent magnet can be made to give up its power, however, if we make it extremely hot, so hot that the molecules of the metal are thrown completely helter-skelter. And now you have guessed what makes a magnet. Yes, it is the arrangement of molecules in the metal. Scientists believe that each molecule in iron (and in a few other substances) is a tiny magnet. When these tiny magnets in a chunk are jumbled together, their forces cancel each other, and the chunk is not a magnet; but it can be made a magnet if its tiny magnets, its molecules, are lined up, with all north poles pointing in one direction, and all south poles pointing in the opposite direction. What are poles?

Dip a bar magnet or a piece of lodestone into some iron filings. You will notice that there are two regions where tufts of filings are thickest; at these places the attraction is greatest. Between these two is a region in which no attraction appears. The regions of greatest attraction are called poles.

You do not have to dip your magnet into the iron filings to make them fasten themselve to the magnet. Just bring the poles near. The filings will leap across the space to the bar. In other words, the space around each pole has magnetism. We call this space a magnetic field. The field can be mapped out by lines of force, as they are called. See the picture on page 4089.

Left: the molecules in this iron bar are jumbled together. Right: with molecules lined up, the bar is a magnet.

In a bar magnet the poles are nearest the ends. When a bar magnet is bent into a horseshoe, the ends are brought together so that the greatest possible pull is at one end. The two poles of a bar magnet are not exactly the same. You can prove this for yourself. Magnetize a steel darning needle by stroking it on the pole of a strong magnet. Take the magnetized needle and stick it through a flat cork. Float the cork in a dish of water. When the needle comes to rest, notice the direction in which it points. Make it point in another direction. It will swing back to its first direction each time. Someone long ago found that a magnetized needle suspended, or pivoted, in this fashion always pointed north and south. The end which always points to the north is called the north pole of the magnet, while the end which always points to the south is called the south pole.

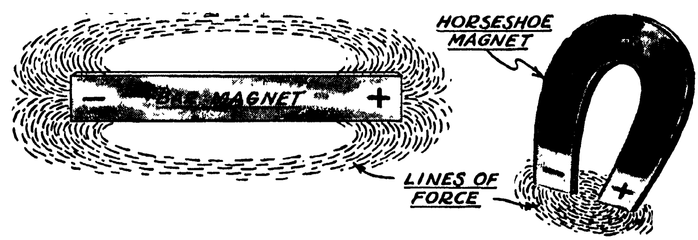
Magnetize another needle and determine its north and south poles by the above method. Now bring the north pole of the second magnet near the north pole of the pivoted one. What happens? The north pole swings away from the similar pole held in the hand. Bring the two south poles near each other. They too repel one another.

This time bring the south pole toward the north pole of the pivoted magnet. They immediately fly together. Try the two other ends, north to south. Here again we find an attraction between the poles.

From these observations we can conclude that like magnetic poles repel, while unlike poles attract each other. Scientists refer to this statement as the Law of Magnets.

The fact that a suspended magnet, when free to swing horizontally, will line itself north and south was early found to be of great value in navigation. Such a pivoted magnet is called a compass. With the compass, mariners could determine direction regardless of whether the sun or stars were visible.

Why does a compass needle come to rest always in a north-south direction? For years scientists wondered about this. Many explanations were offered. It was not until the year 1600 that an acceptable theory came into being, when Sir William Gilbert suggested that the earth itself might be a magnet. That is essentially the theory accepted by modern science. It is thought that the earth itself is a magnet, in fact, the earth behaves as though it had a huge bar magnet thrust through it from pole to pole. If this is so, then the poles of the earth magnet attract unlike and repel like poles of any magnet on earth. Thus we can explain why the compass always points north and south. The end of the compass needle that points north is called the north-seeking end; the other is called the south-seeking end.



If a magnet is placed under a piece of paper covered with iron filings, they will arrange themselves in lines of force like those shown here.

Why should the earth be a magnet? Scientists are still trying to find a satisfactory answer to this question. It was at first thought that the earth's magnetism was the result of large deposits of magnetic iron ore; or the result of the earth's core of iron and nickel. The best theory to date is a very complicated one, telling us that electrons shot out from the sun play an important part in the earth's magnetism.

Compasses usually point a little to one side of true north and south. It was Columbus who first discovered this. The earth, as you know, is rotating. The ends of the axis around which it spins are called North and South Geographic Poles. As it happens, the earth's magnetism is such as might be produced by a huge bar magnet within the earth, having its poles a little to the side of the geographic poles. Actually the magnetic pole in the Northern Hemisphere is in the far northern part of Canada, several hundred miles from the North Geographic Pole. Strangely enough, the magnetic pole shifts from time to time, apparently as much as two or three hundred miles. It is toward this spot that the north-seeking poles of all compasses on the earth point. Because of the wide separation between true, or geographic, north and the magnetic north, only in rare instances will compasses point true north. In New York, for example, the compass pointing to the magnetic north is actually about 11 degrees

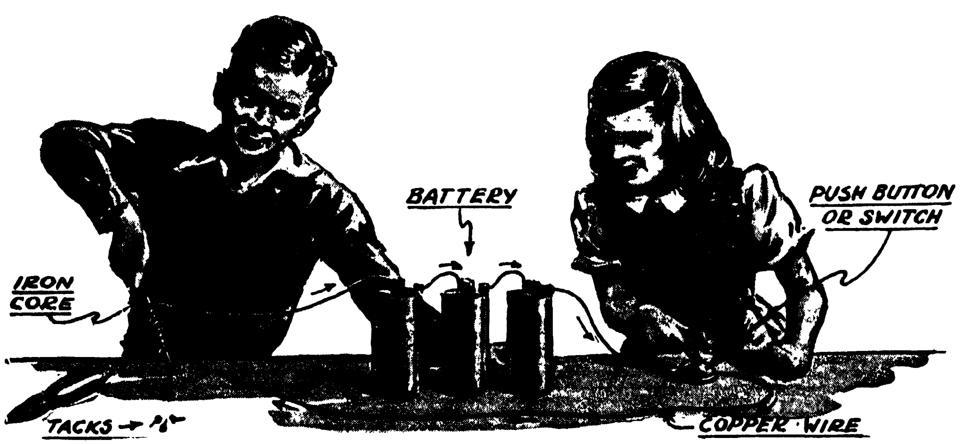
to the west of true north. The only cases in which the compass points true north is when the compass is so situated that there is approximately a straight line between the north geographic, the magnetic poles and the compass. Another puzzling fact is that the earth's magnetic poles move slightly from year to year.

Permanent magnets are used in the telephone receiver and the radio loudspeaker and many, many other modern devices. In developing these devices, scientists sought materials to make very powerful magnets. They discovered many substances which show even greater magnetic properties than steel. Most of these materials are alloys of iron and steel. An alloy is produced when two or more metals are uniformly mixed while in the molten state. Alnico, for example, which is an alloy of aluminum, nickel, copper, iron and cobalt, can be made so highly magnetic that it can lift a thousand times its own weight of iron! Nickel and cobalt by themselves also show magnetism; but, generally speaking, it is iron and steel and their alloys which make magnets. A magnet attracts iron and steel and alloys of these metals. It will not attract gold or silver or wood or other substances.

The magnets of which we have spoken are widely used; but it is another type of magnet which has made possible most of the progress in this age of electricity. That is the electromagnet. The importance of the electromagnet lies in the fact that we can control its strength as we will. The story of the electromagnet began in the year 1820, at the University of Copenhagen. Professor Hans Oersted was lecturing to a group of his students on the latest experiments in electricity. Professor Oersted knew more about electricity than most men of his time, chiefly because back of his laboratory was a barn full of electrical batteries. These batteries provided the good professor with more electric current than any man had ever before controlled, and he made many an experiment.

One day, it so happened that there was a magnetic compass needle on the table in the lecture hall where the professor was conducting an experiment. This needle was close to one of the wires which Oersted was about to connect to his batteries. As the connection was made, the compass needle swung about to a position away from the normal north-south direction. What was this? What made the needle swing that way? There was only one thing which could so influence the magnet without even touching it; it had to be another magnet. Where was this magnet? The professor deduced that the wire itself became a magnet when electricity flowed through it; and that was the explanation.

You may wish to see for yourself what happened. Set a copper wire over a pocket compass so that the wire is parallel with the compass needle as the needle points north and south. Now connect the ends of the wire to the terminals of a single dry cell. You will notice that as the electric current surges through the wire the compass needle swings about and comes to rest in a position across the wire. Such a force, which moves a magnet at a distance, is the force of attraction and repulsion of one magnet for another, which we have already discussed.



How an electromagnet works. The iron bar shown here acts as a magnet only as long as the current is turned on.

A BIG ELECTROMAGNET AT WORK

Acme photo

Electromagnets are widely used in industry. The electromagnet shown above has been magnetized, for the current has been turned on; it picks up huge steel shell casings from the pile. The magnet is then swung around by means of the crane at the left. When it is directly above a rail car the current will be turned off and the casings will drop into the car. They will then be moved to a foundry, where they will be melted in order to provide steel for automobiles, trucks and tractors. The magnet shown here can lift tons of steel at a time.

Oersted demonstrated that a wire carrying a current had a magnetic field around it. It remained for the American scientist Joseph Henry to take advantage of the "magnetic" wire. He reasoned that if the magnetic field spread over a long wire could be concentrated, a very powerful magnet could be made. He therefore bunched together a long wire and sent a current through it. The results were disappointing. Henry soon realized his mistake. The wire was carelessly lumped together so that in neighboring parts the current was flowing in opposite directions: the magnetic fields were therefore neutralizing one another. The only way to reinforce the current would be to have neighboring parts of the wire carry current in the same direction. This could be done by winding a coil. Henry wound many coils of wire. He found that if he wound his wire on a soft iron core the magnetism was apparently concentrated around the coil even more than without the core.

ONE CAN EASILY CONTROL THE STRENGTH OF A MAGNET MADE BY ELECTRICITY

The advantage of such a magnet made by electricity is that the strength of the magnet can be easily controlled. Shut off the current and you no longer have a magnet. Increase the current a little and the magnetic strength increases. Using a steel core for the magnet results in making the steel core a permanent magnet. This is the way in which all artificial permanent magnets are made.

A magnet made by the flow of electricity through a coil is called an electromagnet. The strength of an electromagnet depends on several things. As you have probably guessed, the greater the number of turns, the stronger the magnet. Next, the amount of electricity flowing in the wire also determines the strength of the electromagnet. The greater the current, the stronger the magnet. Lastly, an electromagnet with a good grade of soft iron for its core will be stronger than the same electromagnet using wood, glass or air for its core.

Experimenting with electromagnets is great fun and requires little equipment. One or two dry cells, about twenty-five to fifty feet of #24 enameled wire, a cardboard tube and a few iron nails are all you need to perform many experiments.

Immerse your home-made electromagnet in a heap of iron filings. Note how the filings cluster near the ends. Remove the iron filings and hold one pole of the electromagnet near the north-seeking end of a compass needle. Note that the electromagnet behaves very much like a bar magnet. It has a north-seeking pole at one end and a south-seeking pole at the other. Reversing the direction of the current through the electromagnet causes a reversal of polarity.

Bar magnets are bent into horseshoes to concentrate their magnetic strength. We can do the same thing with electromagnets. We do not, however, waste wire by winding it around the middle of the horseshoe, where there is no magnetic attraction. In winding horseshoe electromagnets we usually wind a coil at each of the ends and connect the coils together. To get maximum lifting power, the two ends should be opposite poles. This is done very easily by winding the two coils in opposite directions.

Electromagnets are widely used in modern electrical devices. Huge electromagnets lift tons of steel at a time; electromagnetic brakes bring trolley cars to smooth, quick stops; and electromagnets separate magnetic particles from flowing streams of non-magnetic materials. The last-named use is important in the metal industry, in separating iron ores from other rocks.

ELECTRIC DEVICES IN WHICH THE ELECTROMAGNET PLAYS AN IMPORTANT PART

The electromagnet is of greatest importance in the electric bell, the telegraph and the telephone. In the section dealing with some of the things which electricity can do we shall learn how the electromagnet is used in these modern devices.

The electric motor also depends on the electromagnet, as we shall explain in the article Electric Motors and Generators. The same article tells how an electric current can be obtained (generated) by rotating a wire or coil between the poles of a horseshoe magnet.

Thus magnetism can be induced by electricity, and electricity can be induced by magnetism. An interesting modern invention that uses magnetism is the steel tape phonograph and dictagraph record. The sound-pattern is recorded on the tape by rearranging the molecules by a magnetic device. Such a tape will not wear out. When the record is no longer desired it can be erased by "scrambling" the molecules. Then another sound-pattern can be put on the tape.

By THEODORE BENJAMIN.

THE NEXT STORY OF SCIENCE IS ON PAGE 4199.

U. S. Forest Service — Davey Tree Expert Co. — Davey Tree Expert Co.

The tree, whether lopsided or spreading or straight and true, is still the crowning glory of the plant world.

THE LIFE *of a* TREE

THE crowning glory of the plant world is the tree. The majesty of the spreading oak and chestnut, the dainty loveliness of the lilac and laburnum, the somber dignity of the cedar and yew, seem to place these trees above the common run of flowering plants. And yet their story is the story of the daisy or the dandelion once again.

A little seed is planted in the ground and soon begins to throw out roots downward and a stem upward. The stem grows, and branches appear bearing leaves and flowers and fruits. The fruits, containing seeds, fall on the ground. The seeds germinate, or sprout, and once again the process is repeated.

For convenience it is common to speak of herbs, shrubs and trees, but there is no sharp distinction dividing one class from the others. Shrubs differ from trees only in their size; or in having several stems which proceed from the ground, or near it; or in having much-forked stems.

Although it is generally true that trees have stout main trunks from which smaller and more slender branches spread out, the trunk of a tree is sometimes short, with branches longer than itself. Sometimes, too, it happens that trees which in favorable circumstances grow to towering heights often become mere shrubs when found in the far north or high on mountain slopes. On high mountains, for instance, the mountain ash is reduced to a low creeping shrub a few inches high.

Davey Tree Expert Co.

White-oak acorns.

Many a man walks through a wood or up a fine avenue of tall trees without giving a thought to the giant plants around him. If he does think of them at all, he does not think of them as things which are as truly alive as himself. Yet a tree is a living and breathing creature. It has a real circulation, digests and assimilates its food and rears a family. It also has the power of adapting itself to its surroundings in a wonderful way. It may lack will-power and intelligence, a nervous system and the power of moving from place to place, but it carries on the activities of life just as truly as the body of a man.

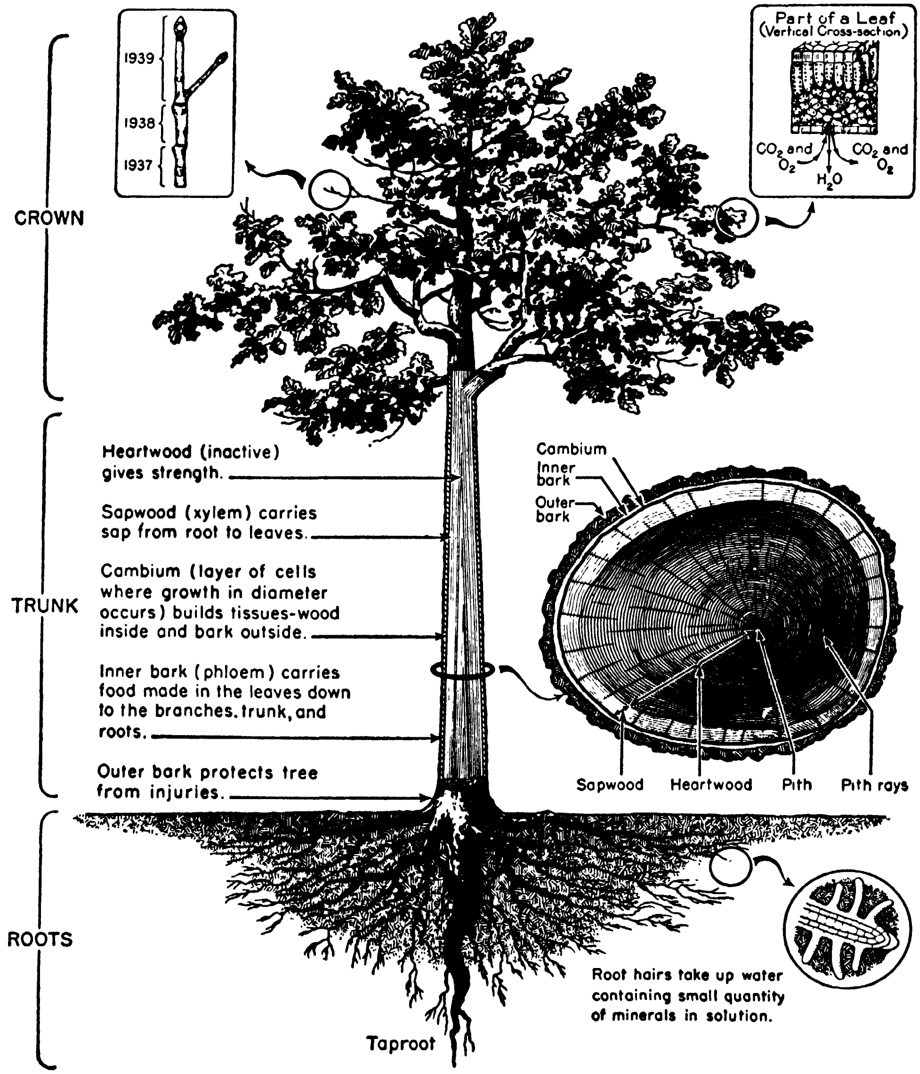
The tree, like other plants, takes in air through its leaves. It enters through tiny openings on the undersides of the leaves. Once inside the leaf, the elements that make up the air—carbon dioxide, oxygen and so on—are separated from one another. When the carbon dioxide, combining with water, is exposed to sunlight, it produces starches, sugars, cell tissue and other substances. This process is called photosynthesis, because it is a synthesis, or putting together, of material in light (*photos,* in Greek).

The oxygen taken in is used by the leaves, as by every living cell in all parts of the plant, in respiration. The process of respiration is much the same in plants as in animals. It represents the union of oxygen with those materials which can combine with oxygen. Respiration and photosynthesis take place together *in*

HOW A TREE GROWS

Trees increase each year in height and spread of branches by adding on a new growth of twigs.

Light and heat are required by the leaves in the preparation of food obtained from the air and soil. The leaves give off moisture by transpiration.



The buds, root tips, and cambium layer are the growing parts. The tree takes in oxygen over its entire surface through breathing pores on leaves, twigs, branches, trunk, and roots.

U. S. Forest Service

sunlight, but photosynthesis is the more vigorous; it does not take place at all in the dark.

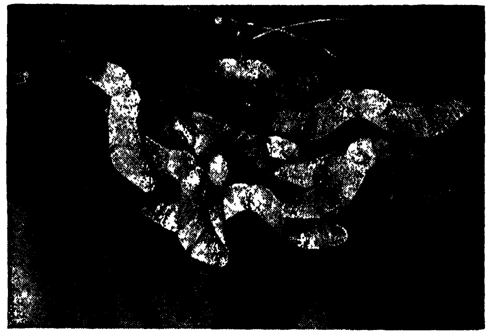
The tree has a circulation as truly as man himself. While it does not move so fast as ours and does not go round and round as the result of pumping by a heart, the circulation system of the tree operates from the tiniest root-hair to the most distant leaf, and back again. On the upward flow the circulation goes on from cell to cell, from the small roots to the larger ones, then into the trunk and branches and leaves. From the leaf, where it is transformed into tree food, the circulation travels down once more through the cells of the inner bark on the way to the smallest roots, building up layers of cells all the time.

Like all other living beings, the tree produces young trees to carry on the race. It arranges that its young shall have as good a start in life as possible. In some cases, as in the sycamore and maple, the seeds are given wings to carry them far enough from the parent tree to find nourishment in the soil. In other cases, as in the coconut, the seed of the future tree is carefully protected from danger and from enemies of all kinds by being wrapped up in armor. Sometimes the male and female flowers are found on the same tree; sometimes on separate trees.

HOW A TREE ADAPTS ITSELF TO ITS SURROUNDINGS

The way in which the tree adapts itself to its surroundings is just as wonderful as the way in which man adapts himself to varying conditions. If water is scarce, the roots go down deeper and deeper; if nourishment is poor, the roots stretch out farther and farther, traveling backward and forward, above and below and around obstacles, in their search for what will be good for the tree. If the trees are crowded together, they reach higher and higher; and their branches, instead of growing outward, rise almost perpendicularly to reach the sunshine. If several trees are grouped together, they grow on one side much more than on the other, in order to accommodate themselves to their fellows. If the situation is windy, the tree takes firmer hold of the ground with its roots.

The tree can meet and defeat most of its enemies, except man. It may bend before the wind, but it rarely breaks; snow and frost it can keep out; animals and birds and insects it can often resist; and in the hard struggle against its own relatives—like the ivy which tries to strangle it—it puts

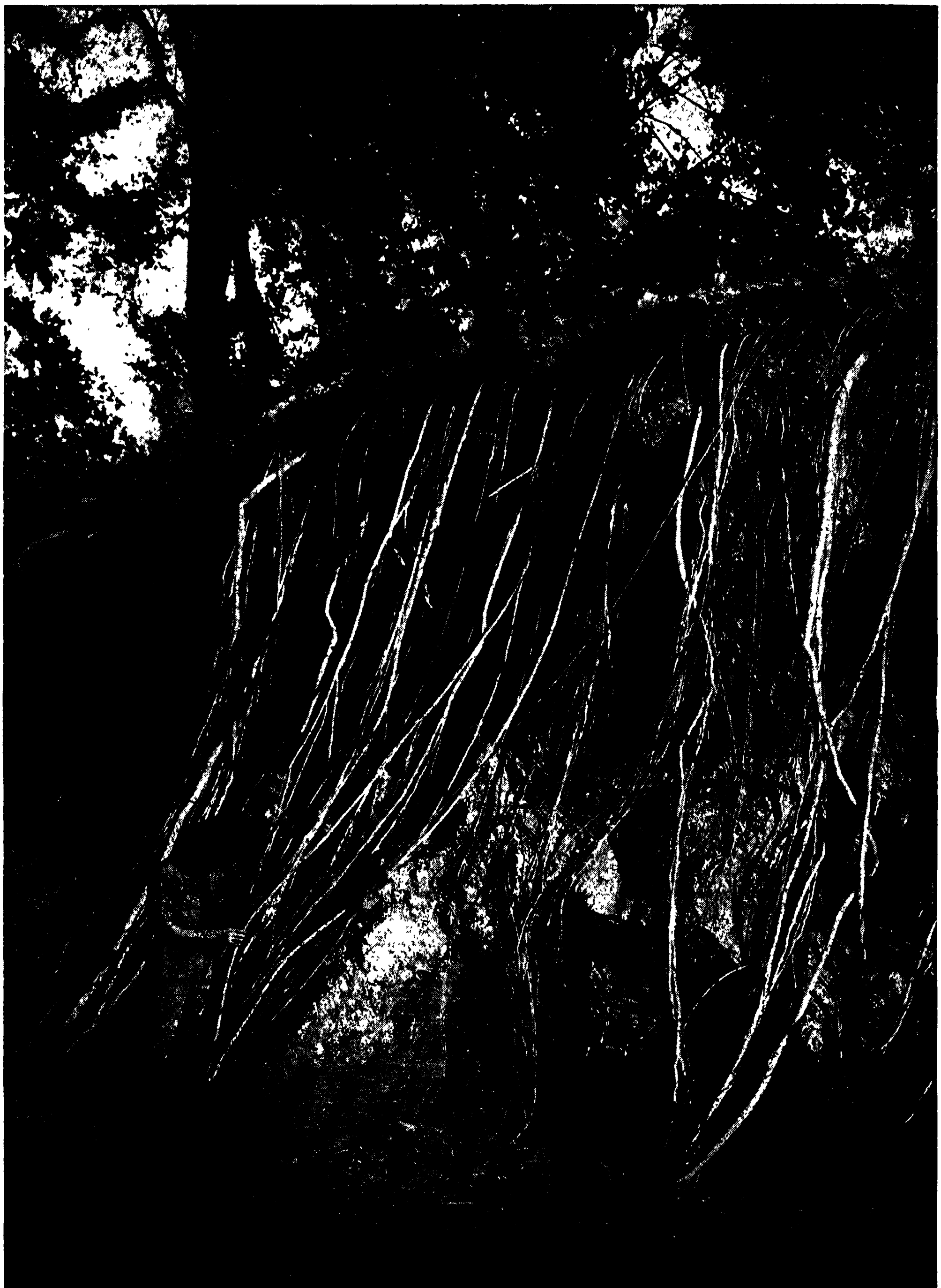


Davey Tree Expert Co.
The winged seed, or samara, of the Norway maple.

Davey Tree Expert Co.
A little cluster of fruit borne by the red mulberry.

Davey Tree Expert Co.
The fleshy, berry-like fruit of the mountain ash.

THE TREE UNDERGROUND



Davey Tree Expert Co.

Here we see a tangled mass of roots reaching deep into the earth in the search for nourishment and moisture.

up a good fight and sometimes wins.

Man can beat the tree every time. But he does so at his own peril, for the trees are the very life of certain areas. Once the trees are gone, the water that their roots held in the ground runs off the surface into the streams, carrying off some of the topsoil with it. As time goes on, more and more of the topsoil is blown away by the wind or washed away by the rains. In many areas cultivation becomes impossible. What was formerly a garden becomes as bare and as silent as the desert.

At one time the mountain slopes of India were covered with magnificent forests, but the trees were cut down. Little did the people realize the evils that would follow such a course; they thought only of present profit. Those seemingly useless trees were, in fact, the most useful servants of India. In the rainy season they stored up millions and billions of drops of water to refresh the earth in the dry season. Now, when the rain falls, there are few forests to catch and store it; the water evaporates or runs away rapidly to the sea, and many large areas are, as a consequence, dry and barren.

WHY WE SHOULD PROTECT AND PRESERVE OUR TREES

Fortunately more and more people have come to know that the trees are our friends. They have come to realize that we should do our best to protect trees, and that wherever possible we should plant new ones to take the place of those which have been cut down. In our chapters on Conservation and on Forests and Their Guardians we tell you of the steps that have been taken to save and replace trees.

How thrilling would be the story of the trees if they could only speak! Think of the giant sequoias of California, with their thousands of years of life! Some of them may have been fully grown when Christ was born. When the first Londoner built his hut on the banks of the Thames, they were old.

The life-and-death struggle among the trees is as fierce as among the animals, and is constantly going on. One of the greatest authorities in the United States Forestry Service states that a forest at maturity contains scarcely 5 per cent of all the trees that have started life there. In some natural pine forests, during the age between twenty and eighty years, over four thousand trees on an acre die, whereas at the age between eighty and a hundred years only three hundred trees an acre die. With some trees this

Davey Tree Expert Co.

The slender, upward-pointing white pine attains heights of 100 to 150 feet in the American West.

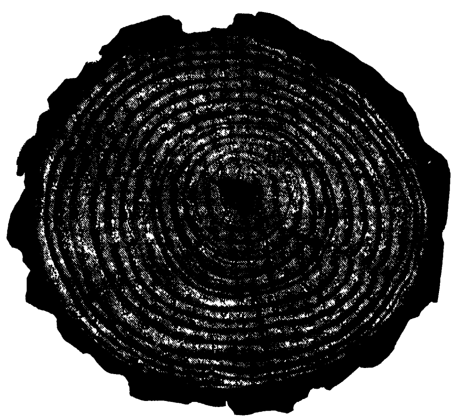
THE GIANT SEQUOIA IN WINTER DRESS

Yosemite National Park

The amazingly old and sturdy giant sequoia trees are often more than 15 feet in diameter and over 300 feet high.

natural dying-out with age proceeds faster than with others. Thus in pine, birch, aspen, and all other species which demand a great deal of light, the death rate is enormous. With spruce, beech, fir and species which are satisfied with less light, the process is less rapid.

The growth of a tree is very wonderful. Except in the buds, leaves, fruit and twigs less than a year old, the new material that results from growth is deposited in a thin coat over the whole tree between the wood and the bark. There is a layer of tissue between the wood and the bark which we call the cambium, and here the new tree-substances are made. The cells on the inner side of the cambium make new wood. The cells on the outside of the cambium make new bark. In addition to the true cambium, which forms both wood and bark, there is another cambium which makes the corky outer bark and nothing else. This cork cambium may encircle the whole tree like the true cambium, or may form little separate films in the bark. In both cases it dies from time to time, and is formed again nearer the wood.



U. S. Forest Service

The annual rings of the longleaf pine.

Wood is chiefly made of small tubes or cells of various kinds which have special uses in the life of the tree. Some cells convey water from the roots to the crown, others store away digested food, and others strengthen the structure of the wood and hold it together. Some cells have thick walls and small openings, while others have wide openings and thin walls. Not all trees, of course, are alike in structure; the wood of the coniferous, or cone-bearing, trees is much simpler than that of trees like the oak and maple.

In climates which have regularly a season of growth and a season of rest each year, the cells of the new wood formed at the inner surface of the cambium are arranged in a definite way. In the spring, when growth begins and fresh leaves and twigs are put out, much water is needed in the crown of the tree to supply these new moist green parts. Water rises in most trees through the new layers of the wood, and especially through the last ring. The result is that the tree at first makes thin-walled cells with wide openings, so that the water can rise rapidly. Later, when there is less demand for water, and there is plenty of digested food available to supply the necessary building material, the cells formed are thick-walled and have small openings. That explains why the summer wood in each year's growth is heavier and stronger than the spring wood. In some trees this difference is quite easy to see.

The rings of growth in the trunk of a tree are spoken of as annual rings, for, so long as the tree goes on living healthily, a fresh ring will be formed each year. Sometimes, for some reason or other, the growth of a tree is interrupted and begins again during the same season, and then two false rings appear; but they are much thinner and do not always extend right round the tree. A drought or a big attack by caterpillars or other insects may lead to interrupted growth and give rise to the false rings.

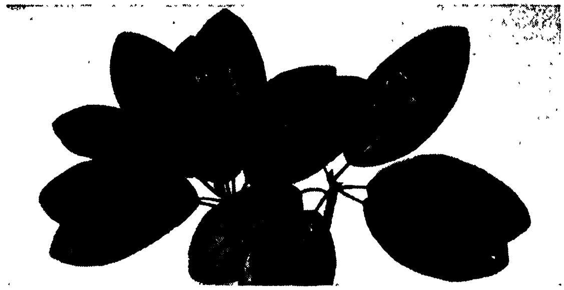
In most trees the wood gets harder as time goes on. The cell openings become choked, and sap can no longer run through them. The wood is then no longer living sapwood, but dead heartwood, for it has nothing to do with growth. It is still useful to the tree, however, for it forms a strong framework which helps to support the living parts of the tree.

We have already shown how the trees benefit us by storing water in the soil. They serve us in countless other ways. We use the wood for lumber; we also use it to make pulp and paper. From cellulose, the vegetable fiber of the cell walls, we make a thousand useful and beautiful things. The bark of certain oak trees provides us with cork. We produce quinine from the bark of the cinchona tree, and tannin, useful in medicine and industry, from the bark of the hemlock. Other trees yield turpentine, rosin, camphor and rubber. Truly a man who plants a tree is a benefactor of mankind.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 4245.

THE BEAUTIFUL MAGNOLIA TREE

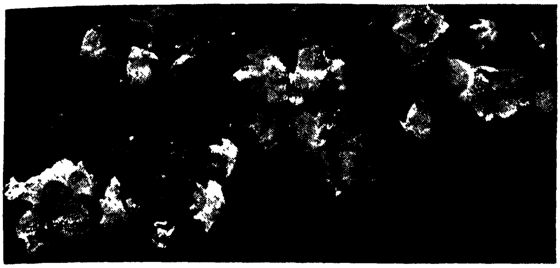
U. S. Forest Service
The lovely, sweet-smelling magnolia blossom.



L. W. Brownell
The leaves of the magnolia tree are smooth and satiny.

Davey Tree Expert Co.
The gracious magnolia tree shown in full leaf after the flowering of the blossoms in the early spring.

THE CATALPA TREE



L. W. Brownell

The tiny, round catalpa buds blossoming into full flower.

U. S. Forest Service

The broad, flat leaves of the catalpa tree.

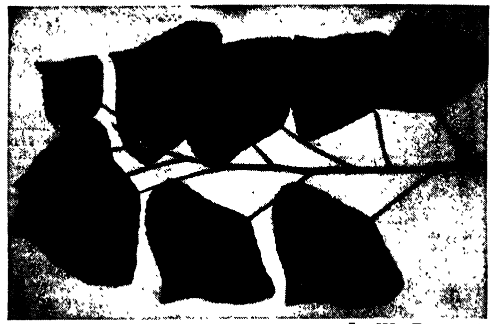
U. S. Forest Service

The catalpa tree is everywhere admired for its beautiful flowers, and serves well as a shade tree for yard and garden.

THE JUNIPER AND POPLAR TREES

U. S. Forest Service

The juniper tree bears rigid needle-like leaves and yields a heavy blue-black fruit which is almost completely hidden in the leaves.



L. W. Brownell

The heart-shaped leaves of the poplar are often bright and glossy, reflecting the light of the sun in an elusive silvery shimmer.

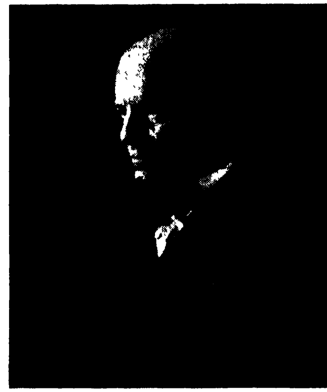
Davey Tree Expert Co.

The juniper tree is one of the loveliest and most common of the many species of evergreen found in the cooler parts of North America.

U. S. Forest Service

The erect and rapid-growing poplar is found almost everywhere in Europe, Asia and North America. It is frequently used as a windbreak.





Keystone View Co. Doubleday & Company Charles Scribner's Sons

Three great story-tellers, modern English novelists—H. G. Wells, Somerset Maugham and John Galsworthy.

ENGLISH FICTION
IN THE TWENTIETH CENTURY

IF we compare the books which are written today with those of a hundred, or even fifty years ago, we see that the novel has changed greatly in form and in style.

The basic subject matter of fiction does not really change, because it must always deal with human beings: their strength and weakness, their hopes and fears and joys and sorrows, and the way in which different ones act in the situations that the author has imagined for them. Even so, the ideas and beliefs and events of the period in which the author writes have much to do with the way his fictional characters think and act.

It would be much more convenient for people who divide history and literature into periods if the world did really change all at once when the calendar changes. But that is not the way things happen. Many of the writers about whom we told you in the chapter on nineteenth-century English fiction were still living and writing long after our own century began. On the other hand, some of those we call twentieth-century authors were writing before 1900. The five novelists that we are going to tell about first all got started before the turn of the century. They are Joseph Conrad (1857-1924), John Galsworthy (1867-1933), Arnold Bennett (1867-1931), H. G. Wells (1866-1946), and W. Somerset Maugham (1874-).

Joseph Conrad was born in Poland and did not go to live in England until he was over twenty years old; but he wrote all of his books in English, and he could write the English language far better than many Englishmen could. When he was twelve years old his father and mother died, and not long afterward Conrad went to sea as a sailor. For many years he visited the ports of the world, chiefly as an officer on British merchant ships. His first novel, ALMAYER'S FOLLY, was published in 1894. It had taken Conrad six years to write this book, but once he was started on a writing career he left the sea and devoted all his time to it.

Most of Conrad's novels and stories are tales of the sea, or of people shut off from civilization in lonely tropical outposts. They are not what we call adventure stories. There is more thought than action in them. Conrad was deeply interested in people as human beings. There are many dramatic situations in his stories, but the author is not so much interested in what his people do as in why they do it, and how it affects themselves and others. Because so much of his life had been spent on ships and among the wanderers in tropical jungles and coral islands, those were the people he chose to write about. Quite a number of his stories are written in the first person, that is, they are told by one of the characters in the story. In these the teller of the tale is usually a man who knew the principal characters and followed the drama of their lives, but took little active part in it himself. Thus the story is told from outside the minds of the persons involved, and as

you read it you almost feel as if you too had watched the drama unfold. Perhaps the most fascinating of Conrad's works are Almayer's Folly, The Arrow of Gold, Heart of Darkness, Youth, Typhoon and Lord Jim. If you read and like any one of these you will be sure to want to read more of his books.

Although Galsworthy and Conrad were great friends as well as great novelists, it would be hard to imagine any two men more different, both in their background and in the character of their novels. John Galsworthy was born in England, educated at Harrow and Oxford and became a lawyer, but soon gave up the law to write novels and plays. Most of his books are about people of the well-to-do upper middle class to which he himself belonged. He saw very clearly their faults and weaknesses as a class, but he also realized the importance of their place in the life of the nation, and he wrote about them sympathetically as well as critically.

Keystone View Co.

Arnold Bennett wrote of the shopkeepers, potters and other people of the Five Towns, which are now a single city in Staffordshire in England's industrial Midlands.

Galsworthy's most famous and best-loved work is The Forsyte Saga. This is made up of three novels, linked together by two "interludes" or short stories. All of them deal with the life through several generations of the Forsyte family, and the whole saga covers the period from 1886 to 1920. In the beginning we see the family still closely bound together and acting as a unit. As the years go on and the older generation die out, their children and grandchildren drift farther apart until, at the end, it is no longer one family. Instead there are several different families, some of whom dislike each other. There are many characters in the book, for the Forsytes were a large family to begin with, and Galsworthy has made them all intensely interesting. Of course the people in the story are of all ages, from little children to quite old people. The most sympathetic and charming scenes in the book are those in which the author shows us old Jolyon Forsyte and his grandchildren together.

Galsworthy wrote another trilogy, or series of three novels, called A Modern Comedy. This carries the lives of some of the Forsytes up to about 1927. Each of these trilogies gives a brilliant and absorbing picture of the life it depicts, but most people consider The Forsyte Saga to be the better of the two. Galsworthy wrote other novels, among them The Country House, The Island Pharisees and The Dark Flower. He also wrote a number of plays which were successful on the stage in England and in America.

Arnold Bennett was born at Hanley, one of the five pottery-manufacturing towns in Staffordshire which have since become a single city, Stoke-upon-Trent. In most cases it hardly matters to the readers of his works where an author was born, but with Bennett it does matter. Many of his novels and short stories, indeed all of the best of them, were written about the Five Towns and the people who lived in them. Even though Bennett left his native town for London when he was about twenty-six years old, and never returned to Staffordshire to live, he loved and understood the people of this bustling industrial area, and he was most at home when writing of them. He knew how to find the romance, the humor and the excitement in the lives of ordinary people, rich or poor, in the smoky, bustling manufacturing towns.

Among the best of his novels are Anna of the Five Towns, The Old Wives' Tale, and a trilogy, Clayhanger, Hilda Lessways and These Twain. The first two books of the trilogy tell the same story from two different viewpoints. In Clayhanger the man is the central character, and in Hilda Lessways the girl with whom he is in love is the central character. These Twain continues the story of their lives after they are married to each other. The first of the three books is generally thought

to be the best, but the three together are well worth reading.

RICEYMAN STEPS, another of Bennett's greater works, is the story of a husband and wife, both of whom are terribly miserly. The reader becomes intensely interested in this unlovely couple, and in the way their avarice affects the lives of those around them.

Arnold Bennett wrote an enormous number of novels and short stories. Not all of the novels are as fine as the ones we have mentioned, but they are always brilliant and entertaining. His short stories are delightful, especially those in the two books, THE GRIM SMILE OF THE FIVE TOWNS and THE MATADOR OF THE FIVE TOWNS.


Culver Service
Joseph Conrad wrote of the sea.

Herbert George Wells was born in Bromley, a village which has since become a part of London. His father was a struggling shopkeeper, and the boy began helping in the shop when he was quite young. When he was eighteen he received a scholarship to the Normal School of Science at Kensington. There he gained the knowledge that was later to make him the first English writer of scientific novels.

Wells wrote an amazing number of books, sometimes as many as four or five in a year, besides a large number of magazine articles and short stories. His novels are of three distinct types: scientific romances, such as THE TIME MACHINE and THE WAR OF THE WORLDS; stories of the lives and struggles of the kind of plain people among whom he himself grew up, such as KIPPS, TONO-BUNGAY and THE HISTORY OF MR. POLLY; and novels of social criticism, such as ANN VERONICA, JOAN AND PETER, THE WORLD OF WILLIAM CLISSOLD and THE AUTOCRACY OF MR. PARHAM. The novels in this last class are not always interesting as stories, because the characters spend much of their time in long discussions as to what is wrong with our modern world and how it may be put right. This habit makes the books seem more like sermons or lectures than like fiction.

Of the other two general types of novel written by Wells, the scientific thrillers are the most exciting and fantastic. There is the story of the man who learned how to make himself invisible, but who died of cold and hunger because he had not learned how to change himself back into solid matter again. Then there is the story of the time machine, which enabled a man to enter the world of the past or the world of the future. Perhaps the one which seems nearest to reality today is the story of the terrible war between people of different planets. Of all H. G. Well's fiction, his stories of the ups and downs of plain people are the most appealing and will probably be the most enduring. In these stories Wells put bits of his own deeply felt experience as a boy and as a young man.

The last of this group of fiction writers whose work has spanned the first half of our century, and whose popularity is still immense, is Somerset Maugham. William Somerset Maugham is a physician and surgeon, but he became a professional author in his early twenties, before he had finished his medical education. Just as a surgeon uses his tools with precision and with no waste of time or motion, so Maugham uses the words which are the author's tools. For this reason he is able to get a lot more story into fewer words than many other writers can. He has written many short stories and a number of novels, though nowhere near so many as his friend Arnold Bennett wrote. Maugham's works show more variety than Bennett's.

Maugham has traveled all over the world, and he has used his travels and the places and people he has seen as raw material for the colorful and varied stories that he writes. His earliest successful novel, LIZA OF LAMBETH, was written about the people of the London slums; a part of the city's life of which he saw a great deal when he was training in the wards of a big hospital. THE PAINTED VEIL is a story about China, and much of THE MOON AND SIXPENCE takes place in the South Seas. In this book the main character, Strickland, was suggested by the life of the French painter Gauguin. Strickland is an artistic genius who leaves his family and friends for the sake of his painting. He drifts about the world until he reaches Tahiti, where he spends the rest of his life, painting in his own strange man-

ner, for his own satisfaction, until he dies of leprosy. Not a cheerful story, as you can see, but an intensely interesting one.

The most highly praised of Maugham's novels is OF HUMAN BONDAGE. It is the story of a young man's life, from childhood until he is about thirty, and shows his mental and spiritual growth through years of struggle and disappointment. It is told with great realism, and many of the details of character and background were drawn from the author's own observation and experience at school, in the hospital and while living in Paris and Heidelberg. It is not, however, the story of Maugham's own life as some people have supposed.

We have told quite a bit about these five men, Conrad, Galsworthy, Bennett, Wells and Maugham, because they have been so prominent in the English literary scene for more than a third of the present century, and they were all especially well known for their novels and short stories. Galsworthy, Bennett and Maugham also wrote plays, and Wells has written factual books like his OUTLINE OF HISTORY and a vast number of articles.

Keystone View Co.

G. K. Chesterton wrote jolly novels, like THE FLYING INN, and detective stories.

We come now to a famous author of this period who is rather more widely known for his essays, verse, critical and historical writing than for his fiction. This is Gilbert Keith Chesterton (1874-1936). You may read more about him in the chapter about the writers of English essays. Chesterton wrote a number of novels, filled with wit, philosophy and fantasy. They are delightful to read. The best known of these are THE MAN WHO WAS THURSDAY and THE NAPOLEON OF NOTTING HILL. Chesterton's greatest accomplishment in fiction, however, was the creation of Father Brown, the little Catholic priest who solves all sorts of mysteries and crimes. There are several volumes of Father Brown detective stories and there is no more appealing sleuth in all the range of mystery fiction. He is devout, kindly and simple; it is Father Brown's simplicity that enables him to see through false clues and misleading evidence to the true solution. This is all told in Chesterton's swift, smooth and sparkling manner.

As we look back over the first half of the twentieth century, we find ourselves counting the years before World War I as a separate period from the years between it and the second World War. That is, 1900 to 1914 makes one period; 1919 to 1939 makes the second period. The young writers who came after World War I could not help having other viewpoints from those writers who had been well established before it. It would not be possible for us to tell of all the important and interesting fiction written in these two periods, so we shall choose a number who will give a fair view of each period.

Hugh Walpole (1884-1941), Compton Mackenzie (1882-) and Francis Brett Young (1884-) began to be well known in the years before World War I. Walpole was a writer whose fiction has a good deal of variety, and was therefore interesting to many different kinds of readers. To boys and girls, and also to grown-ups, one of his most attractive books is JEREMY. This is the story of a boy, and into it he has woven many memories of his own childhood. JEREMY was followed by JEREMY AND HAMLET (Hamlet was Jeremy's dog), and JEREMY AT CRALE, which gives an interesting picture of English school life of the period. THE CATHEDRAL was another novel written out of Walpole's own young days. Walpole's father had been an Anglican clergyman and a teacher, and Hugh was familiar with the life that centers around a church.

Walpole liked to write groups of novels having the same, or related, characters. One of the most colorful of these groups is that which is called the Herries group, from the name of the colorful, swashbuckling man who swaggers his way through the pages. These books are ROGUE HERRIES, JUDITH PARIS, THE FORTRESS, and VANESSA. In another story, PORTRAIT OF A MAN WITH RED HAIR, he has woven a tale full of horror and suspense. In THE DUCHESS OF WREXE he gives a fascinating picture of Eng-

lish social life in the last years of Queen Victoria's reign. These are but a few of his books, for Walpole, from the time he began having books published, wrote about one a year.

Compton Mackenzie belongs to a family which has been prominent in the British theater for generations, and he himself started out by writing plays. His first successful novel, CARNIVAL, takes us behind the scenes in the world of the theater. SINISTER STREET, one of his best-known novels, has such varied and contrasting settings as Oxford University, the criminal underworld of London, the age-old beauty of Rome and the quiet English countryside. All of his novels have a wealth of drama, even when there is not much action.

Francis Brett Young was born in Worcestershire, near the Shakespeare country, and he has written much about that lovely part of England. One of his most charming books is PORTRAIT OF CLARE (published in America as LOVE IS ENOUGH). Many people like best his stories of the countryside, but DEEP SEA, DR. BRADLEY REMEMBERS and THE CRESCENT MOON, which have different settings, have quite as much charm. Young is a physician, but ill health forced him to give up his practice after the first World War. He is also a musician and composer of music. Medicine, music and the sea are three interests that are present in most of his books.

Two brilliant, but quite different, novelists are Rose Macaulay and Sheila Kaye-Smith (1881-), both of whom became known in the years just before World War I. Miss Macaulay writes about the ups and downs of families, individuals and groups of unrelated characters in a way that is extremely entertaining. The author, however, seems more amused at her people than sympathetic toward them. For this reason she is best when she is writing satirical fiction, such as POTTERISM, which makes fun of a certain type of middle-class life and thought in England. Another, ORPHAN ISLAND, tells of a shipload of orphans and their prim governess who build up an imitation Victorian civilization on a desert island. Still another, TOLD BY AN IDIOT (the title is a quotation from Shakespeare's MACBETH) makes rather sharp but clever fun of a family whose members are always taking up the latest fashions in religion, politics and social ideals.

Keystone View Co.

Here is Hugh Walpole, who wrote of a boy, Jeremy, and his dog and his school.

In the books of Sheila Kaye-Smith there is no light touch of humor, but there is intense feeling. Most of her stories are about rural life in Sussex, and a number of them center about the members of a single family group, the Alards. This writer has a strong religious nature, a deep love of the land and a sense of human tragedy, and all of these qualities appear in her books. Some of her stories that you may read some day are JOANNA GODDEN, TAMARISK TOWN, and THE END OF THE HOUSE OF ALARD.

Before we go on to the years between the wars, we must tell a little about three writers, each quite different from the others, and each having an unusual appeal to readers of all ages. These three men are Kenneth Grahame (1859-1932), James Stephens (1882-) and W. H. Hudson (1841-1922). Perhaps many of you have read THE WIND IN THE WILLOWS, by Kenneth Grahame, and have delighted in the adventures of Mole and Rat, the wise Mr. Badger and the outrageous Toad of Toad Hall. Grahame wrote this story for his own little son, and while it is perhaps specially suited for readers of ten or twelve years old, the book casts its magic spell on readers who are twice or three times that age. Kenneth Grahame wrote two other books that have become classics: THE GOLDEN AGE and DREAM DAYS. These are collections of short stories, most of them taken from his memories of his own childhood. One of the stories, THE RELUCTANT DRAGON, was made the basis of a delightful Walt Disney movie. Grahame's books have gone into many editions.

James Stephens is an Irishman born in Dublin. His books have all of the qualities that we like to think of as being typically Irish: a poetic imagination, the kind of wit that warms but does not burn, and a dry,

humorous wisdom. He combined all of these qualities in his best-known book, THE CROCK OF GOLD. It is difficult to describe this book: its title comes from the treasure that is guarded by the leprachaun, the fairy shoemaker, and it has in it folklore, philosophy and nonsense, so skillfully blended that the story seems to flow along all by itself, without any help from a mere author. Another of his books, DEIRDRE, is based on the life of a legendary princess of ancient Ireland. It is not easy to make the characters of ancient mythology seem alive and important to modern readers, but Stephens does this and still keeps the twilight magic of the Celtic folklore.

William Henry Hudson, an Englishman born in South America of North American parents, wrote misty, idyllic stories of the forests and grasslands of South America. In some ways he was more a naturalist than a novelist; but two of his novels, GREEN MANSIONS and THE PURPLE LAND, are as magical as their titles. They have a far-off, legendary quality that is quite different from the realism of most modern fiction.

HOW NOVELISTS WROTE ABOUT WORLD WAR I AND ITS EFFECTS ON ENGLISH PEOPLE

The first World War brought with it a wave of stories about the war. Many of these were, of course, simply popular romances with a wartime setting, but there were some which tried to show the effect of the war on the lives and ideals of individual men and women of England. Some of the writers we have already told about, such as Galsworthy and H. G. Wells, have left us vivid pictures of that period of stress and change and the unsettled, feverish times that followed it. It is not always the greatest novelists who succeed in capturing and preserving the life of the society in which they live. Sometimes a lesser writer, who concentrates on one section of society within one brief period, can produce a brilliant and unforgettable picture.

Such a writer is Stephen McKenna (1888-) who writes about a small, but not unimportant world, the sophisticated and wealthy classes of London society. This is a class which, in each age, seems to be dying, yet is always renewed from below. McKenna wrote several novels about these people as they appeared to him during the years from 1914 to about 1921, and these are probably the most interesting of all his books. The best-known of these books are SONIA, LADY LILITH, SONIA MARRIED and THE EDUCATION OF ERIC LANE. Many of the same characters appear in all of them, and the author writes about them and their mistakes and weaknesses with a curious mixture of disapproval and sympathy. The reader gains an exciting and rather tragic view of this society as it existed before the changes brought about by the Great Depression and World War II.

MANY YOUNG WRITERS CRITICIZED CONDITIONS; OTHERS SUGGESTED IMPROVEMENTS

After the first World War times were very unsettled in Britain as well as in the rest of the world, and many young writers used their talents to criticize the conditions that they saw about them. Some even offered suggestions for improving those conditions. Of course, there were a great many different opinions as to what was wrong with the world, but the very diversity of views made for a lively and interesting period in English fiction.

Two other things that marked much of the fiction written between the world wars were extreme freedom of expression and a tendency to use the methods and ideas of Freudian psychology. Many fiction writers used words and talked about matters which would not have been considered proper a few years before. This had the effect of shocking many people and pleasing others, but after some years readers and writers alike became used to it, and sometimes even a little bored by it.

Freudian psychology is a method of probing and analyzing the actions and thoughts of human beings. The system was developed by a Viennese physician, Sigmund Freud. He and his followers believed that many mental and physical ailments could be explained and then corrected by using what they called psychoanalysis. It was toward the end of World War I that psychoanalysis became generally known to people in all countries. Novelists and fiction writers drew from it an exciting new way of showing the reader the thoughts and motives of their characters. While most authors did not actually use the terms and methods of Freud, they picked the features of the new fashion which fitted in with the writing of fiction. Such novels are called psychological novels. The reader is given a view inside the minds of the characters.

One way of doing this was to tell the story by giving all the thoughts which happened to be passing through the minds of the principal characters at a given time. You know

how our thoughts jump around from one subject to another: how one thing suggests another, and how all kinds of memories, wishes, fears and hopes weave in and out of our minds even when we are trying to concentrate on one particular subject. D. H. Lawrence, James Joyce and Virginia Woolf and many other writers of the period used this habit of the human mind to make the whole story unfold itself from the thoughts of the characters. Naturally, if this is carried to extremes, it takes a great many words to tell even a rather slight story. James Joyce, for example, in his ULYSSES, covers a wide range of characters and events through the thoughts of his main characters during about eighteen hours. In MRS. DALLOWAY Virginia Woolf uses the same means in dealing with a single day in the life of her heroine.

Not all of the authors who use this "stream of consciousness" type of writing go to such extremes, but you will notice that almost all fiction now, even detective stories, use it to a certain extent.

Among the writers who came to prominence between the wars, Aldous Huxley (1894-) and Richard Aldington (1892-) reflected especially well the restlessness and dissatisfaction of the age. Beyond this, and the fact that both men began as poets, they had little in common. Huxley came from a family famous in science, and he intended to follow a scientific career himself, but an illness while he was still at school made him almost blind. Even today his eyesight is very poor, although it has been improved. This did not prevent him from writing several of the most brilliant novels of the 1920's and '30's. CROME YELLOW, POINT COUNTER POINT and ANTIC HAY are ruthless, hard, bitter pictures of the world as it appeared to Huxley at the time. The people he wrote about were not admirable, and he wrote about them with a sort of disgust. This became more emphatic in some of his later novels, such as EYELESS IN GAZA and AFTER MANY A SUMMER DIES THE SWAN. Since this novel came out, in 1939, Huxley's chief interest has been in writing essays, biography and other non-fiction. In this field his mood of revolt seems to give way to one of exalted hope, almost of romantic mysticism. Like Wells and Bennett, he is one of those people who seem to be born to write, and in spite of poor sight, he has turned out a full-length book almost every year, besides many articles.

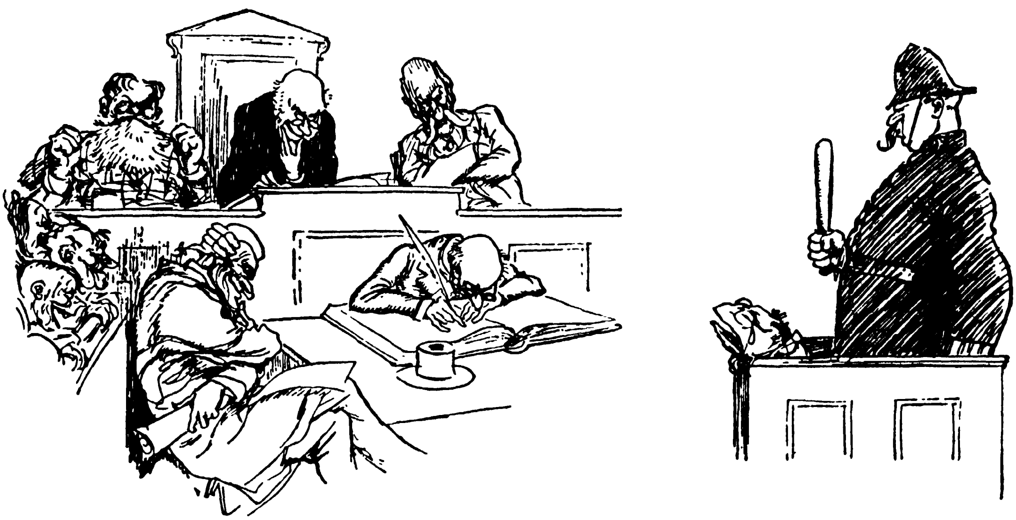


Illustration by Ernest H. Shepard, courtesy Charles Scribner's Sons
Here is Mr. Toad of Toad Hall in the courtroom. Kenneth Grahame wrote about him in THE WIND IN THE WILLOWS.

Richard Aldington showed more anger than disgust in his novels, DEATH OF A HERO and THE COLONEL'S DAUGHTER. He had been a leader in the famous Imagist group of poets before World War I, and had served in the war and had come through it with broken health and with no money. All of the anger and bitterness that he felt seems to have helped to make these novels strong and compelling. His more recent fiction has not had

the drive and power of these earlier books.

Robert Graves (1895-) was another young poet who lashed out at the world that he came back to after World War I, but he did not express himself in fiction until some years later. Then he wrote two quite fascinating books about the days of the Roman Empire. They are I, CLAUDIUS, and CLAUDIUS THE GOD, about an ancient Roman emperor. In these novels he makes his imperial hero as lifelike and understandable as if he were living today.

A most distinguished woman writer of this period is Rebecca West (1892-). It is unfortunate that she has not devoted her talents much to fiction, for two of her novels, THE RETURN OF THE SOLDIER and THE JUDGE are remarkable studies of character. The first of these is about a soldier who suffers from amnesia, and has lost the memory of several years of his life. The story of his cure is most appealing, and it gives an absorbing view of modern psychological treatment.

PRIESTLEY, WHO WROTE ABOUT YORKSHIRE AND GAVE US "THE GOOD COMPANIONS"

Two novelists whose popularity has grown throughout the 1930's and '40's are J. B. Priestley (1894-) and A. J. Cronin (1896-). John Boynton Priestley is a Yorkshireman, and he has been particularly successful in presenting Yorkshiremen in his stories. Yorkshire is the biggest county in England, just as Texas is the biggest state in the United States, and just as Texans are supposed to have special characteristics of their own, so the genuine Yorkshireman is regarded by himself and by his follow Britons as a special breed.

Priestley has written a number of plays, articles and non-fiction works, but his chief claim to fame rests on his novels; particularly THE GOOD COMPANIONS and ANGEL PAVEMENT. They are quite long novels, in which a group of people meet and travel about together. Priestley has sometimes been compared to Dickens, partly because these novels have some of the flavor of PICKWICK PAPERS.

Archibald Joseph Cronin is a physician who practiced in Scotland, in Wales and in London until, in 1930, his health broke down and he wrote his first novel, HATTER'S CASTLE. Many people think that this is still his finest work. THE CITADEL, a story about a physician, and THE KEYS OF THE KINGDOM, about a Catholic priest, had a tremendous success.

Most of the fiction we have been telling about has had a certain seriousness of purpose along with the telling of a story. Sometimes the author has been concerned with the struggles of individual characters; sometimes the story has been developed from the problems of a group or of a whole society. There are, however, many writers to whom the story itself is the most important thing. They like to tell of the lives and adventures of colorful people in picturesque or unusual surroundings. Such fiction is extremely popular, and the best of it is well worth reading.

We might place in this group such entirely different kinds of writers as Daphne Du Maurier (1907-), C. S. Forester (1899-), Thomas Burke (1886-1945), Margaret Kennedy (1896-) and John Buchan (1875-1940). Daphne Du Maurier is a granddaughter of the artist and novelist George Du Maurier, who wrote TRILBY and PETER IBBETSON, two romantic stories which are still read and acted after fifty years. Daphne Du Maurier's two best novels, JAMAICA INN and REBECCA may have as long a life as her grandfather's masterpieces. JAMAICA INN takes place in a smugglers' hideout on the wild coast of Cornwall, about the end of the eighteenth century. It is full of mystery and suspense and romance. REBECCA, a story of the present day, carries the reader deeper and deeper into the secret life of a beautiful, willful woman. The suspense becomes almost unbearable; then comes a "surprise ending."

GRAND ADVENTURES ON LAND AND SEA ARE THE STORIES ABOUT CAPTAIN HORNBLOWER

Anyone who has not read the adventures of Captain Horatio Hornblower, in Cecil Scott Forester's splendid story of the Napoleonic naval wars, has a treat in store. The hero, one of the most likable in modern romantic fiction, is a British naval officer whose duties take him across the Pacific to the coast of Central America, and back again to take part in battles in the Mediterranean and the Bay of Biscay. He has all kinds of adventures on land and on sea. Mr. Forester's knowledge of sailing ships helps to give the reader a real understanding of what it was like to sail and fight in the old frigates and ships-of-the-line.

Thomas Burke wrote of the East End of London, where the docks are, and where, before World War II, strange colorful characters were to be found in the slums and alleys. His best stories, perhaps, are in the collection called LIMEHOUSE NIGHTS.

Margaret Kennedy's most famous novel is

THE CONSTANT NYMPH, the story of a strange, mixed-up family who traveled all over Europe and whose great passion for music affected their lives in curious ways. RED SKY AT MORNING shows the difficulties of life in the family of a genius.

John Buchan, Lord Tweedsmuir, was a many-sided man: a statesman, a lawyer, a business man, and a writer of histories, historical novels and modern romances of adventure. His historical novels are especially good because the writer was not only thoroughly familiar with the times and the people about which he wrote, but he was also, like Scott and Stevenson, a natural teller of tales. In THE BLANKET OF THE DARK he tells a tale of the days when King Henry VIII was breaking up the religious houses in England. MIDWINTER is a story centering about the defeat of the Young Pretender of 1745. WITCHWOOD is a story of Scotland in the days of Montrose.

Keystone View Co.
John Buchan, Lord Tweedsmuir.

Buchan's modern adventure romances, such as THE THIRTY-NINE STEPS, GREENMANTLE, HUNTINGTOWER and CASTLE GAY, are filled with escapes and hurried journeys. They are outdoor books; the characters climb mountain peaks and wander over moorlands and through forests. Many of the same characters appear in several of the books, which fall into groups, or series, a favorite device of British writers.

Because Britain is a "tight little Isle," and families do not get so scattered as they are likely to in the United States and Canada, it is not surprising to find families in which almost every member writes books. Several of the fiction writers we have already told about have had aunts or uncles or grandparents who were famous writers. Now we shall tell of a few present-day families of writers.

There is the Gibbs family: Sir Philip Gibbs, his two brothers, Hamilton Gibbs, Cosmo Hamilton Gibbs (he wrote under the name Cosmo Hamilton) and his son, Anthony Gibbs. Sir Philip Gibbs (1877-) is equally famous as a newspaper correspondent and as a novelist. Cosmo Hamilton (1872-1942) wrote novels but was more celebrated as a playwright. All of them have written many non-fiction books and articles.

The Waugh family's most famous members are Arthur Waugh (1866-1943), a publisher, editor and writer of biographies and books of plays for children, and two sons, Alec and Evelyn. Alec Waugh (1898-) started out by writing a novel of school life which infuriated the authorities of the school which he had attended. Since then he has written much fiction and several books of travel. Evelyn has also done travel books of a rather grim sort, but he is best known for such novels as A HANDFUL OF DUST, DECLINE AND FALL and PUT OUT MORE FLAGS. His novels tend to be malicious rather than bitter. He shows little admiration for the human race.

Edith, Osbert and Sacheverell Sitwell are aristocratic, eccentric and witty in their writings, but neither the sister nor the brothers have written much straight fiction. It is in verse of a highly individual kind, in malicious, witty comment, and in romantic excursions into the past that they are most at home.

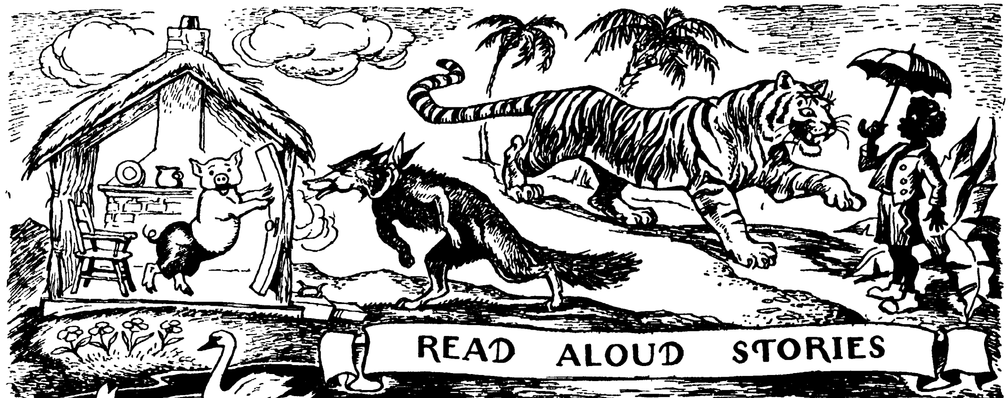
There have been literally hundreds of fiction writers in Britain during our century, and they have written thousands of books. Some books which we today think highly of may be forgotten in a few years, while others may be read by our children and grandchildren. In this chapter we have tried to include a well-rounded selection, but as you read more and learn more of the literature of our times, you will find many others equally important and some perhaps even more interesting. The list below gives some additional British fiction writers and a few of the best-known books each has written.

SOME OTHER BRITISH WRITERS OF FICTION

Margery Allingham (1904-)
FLOWERS FOR THE JUDGE
DANCERS IN MOURNING
TRAITOR'S PURSE
Michael Arlen (1895-)
THE GREEN HAT
THESE CHARMING PEOPLE
Maurice Baring (1874-1945)
CAT'S CRADLE
DAPHNE ADEANE
TINKER'S LEAVE

Phyllis Bottome (1884-)
The Dark Tower
The Crystal Heart
The Mortal Storm
Agatha Christie
The Murder of Roger Akroyd
Murder in the Calais Coach
And Then There Were None
Warwick Deeping (1877-)
Sorrell & Son
Old Pybus
E. M. Delafield (1890-1943)
The Diary of a Provincial Lady
No One Now Will Know
Norman Douglas (1868-)
South Wind
Alone
Elizabeth (pen-name of Countess Russell) (1866-1941)
Elizabeth and Her German Garden
The Enchanted April
Mr. Skeffington
Jeffery Farnol (1878-)
The Amateur Gentleman
The Broad Highway
Over the Hills
Ford Madox Ford (1873-1939)
Some Do Not
No More Parades
A Man Could Stand Up
The Last Parade
W. L. George (1882-1926)
The Second Blooming
The Confession of Ursula Trent
Louis Golding (1895-)
Magnolia Street
Mr. Emmanuel
Maurice Hewlett (1861-1923)
Richard Yea-and-Nay
A Lover's Tale
Robert Hichens (1864-)
The Garden of Allah
Barbary Sheep
James Hilton (1900-)
Goodbye, Mr. Chips
Lost Horizon
Random Harvest
Winifred Holtby (1898-1935)
South Riding
Anthony Hope (pen-name of Sir Anthony Hope Hawkins) (1863-1933)
The Prisoner of Zenda
Rupert of Hentzau
A. S. M. Hutchinson (1880-)
If Winter Comes
This Freedom
He Looked for a City
Eric Knight (1897-1943)
The Flying Yorkshireman
Lassie Come-Home
This Above All
Katherine Mansfield (1888-1923)
In a German Pension
Prelude
Leonard Merrick (1864-1939)
Conrad in Quest of His Youth
The Man Who Understood Women
George Moore (1852-1933)
Esther Waters
Evelyn Innes
The Brook Kerith
Charles Morgan (1894-)
Portrait in a Mirror
The Fountain
John Cowper Powys (1872-)
Wolf Solent
Owen Glendower
Llewelyn Powys (1884-1939)
Apples Be Ripe
Love and Death
Theodore Francis Powys (1875-)
The House With the Echo
Goat Green
Henry Handel Richardson (pen-name of Henrietta Robertson) (1880?-1946)
Maurice Guest
The Fortunes of Richard Mahony
Rafael Sabatini (1875-)
Scaramouche
Captain Blood
Victoria Sackville-West (1892-)
The Edwardians
All Passion Spent
Saki (pen-name of Hector Hugh Munroe) (1870-1916)
The Unbearable Bassington
Chronicles of Clovis
Dorothy Sayers (1893-)
Strong Poison
The Nine Tailors
Gaudy Night
May Sinclair (1865?-1946)
Mary Olivier
Anne Severn and the Fieldings
Lady Eleanor Smith (1902-1945)
Romany
Portrait of a Lady
G. B. (Gladys Bronwyn) Stern (1890-)
The Matriarch
Mosaic
A Deputy Was King
Frank Swinnerton (1884-)
Nocturne
Harvest Comedy
H. M. Tomlinson (1873-)
Gallions Reach
All Our Yesterdays

THE NEXT STORY OF LITERATURE IS ON PAGE 4204.



THE MOUSE AND THE SAUSAGE

ONCE upon a time a little mouse and a little sausage, who loved each other like sisters, decided to live together.

One day, when the little sausage had prepared cabbage for dinner, the little mouse, who had come back from town with a fine appetite, enjoyed it so greatly that she exclaimed: "How delicious the cabbage is today, my dear!"

"Ah!" answered the little sausage, "that is because I popped myself into the pot while it was cooking!"

On the next day, as it was her turn to prepare the meals, the little mouse said to herself: "Now I will do as much for my friend as she did for me; we will have lentils for dinner and I will jump into the pot while they are boiling," and she let the action follow the word, without reflecting that a simple sausage can do some things which are out of reach of even the wisest mouse.

When the sausage came home, she found the house lonely and silent. She called again and again, "My little mouse! Mouse of my heart!" but no one answered. Then she went to look at the lentils boiling on the stove, and alas! found within the pot her good little friend. Poor mousie had stayed in the pot too long!

The little sausage could never be consoled! That is why today, when your mother cooks a sausage in the frying pan, you will hear it weep and sputter: "M-my p-poor m-mouse! A-ah, m-my p-poor m-mouse!" You listen . . . and see!

THE THREE GOATS

RETOLD BY EMILIE POULSSON

Then the hare, too, sat down in the field and cried.

Now you shall hear!

There was once a boy who had three goats. All day they leaped and pranced and skipped and climbed up on the rocky hill, but at night the boy drove them home. One night, when he went to meet them, the frisky things leaped into a turnip field and he could not get them out. Then the boy sat down on the hillside and cried.

As he sat there a hare came along. "Why do you cry?" asked the hare.

"I cry because I can't get the goats out of the field," answered the boy.

Then the fox sat down with the hare and the boy and cried.

"*I'll* do it," said the hare. So he tried, but the goats would not come. Then the hare, too, sat down and cried.

Along came a fox.

"Why do you cry?" asked the fox.

"I am crying because the boy cries," said the hare; "and the boy is crying because he can not get the goats out of the turnip field."

"*I'll* do it," said the fox.

So the fox tried, but the goats would not come. Then the fox also sat down and cried.

Soon after, a wolf came along. "Why do you cry?" asked the wolf.

"I am crying because the hare cries," said the fox; "and the hare cries because the boy cries; and the boy cries because he can't get the goats out of the turnip field."

"*I'll* do it," said the wolf. He tried, but the goats would not come.

So he sat down beside the others and began to cry, too.

After a little, a bee flew over the hill and saw them all sitting there crying. "Why do you cry?" said the bee to the wolf.

"I am crying because the fox cries; and the fox cries because the hare cries; and the hare cries because the boy cries; and the boy cries because he can't get the goats out of the turnip field."

Wolf and fox and hare and boy sat down and cried.

"*I'll* do it!" said the bee.

Then the big animals and the boy all stopped crying to laugh at the tiny bee. *He* do it, indeed, when they could not! But the tiny bee flew away into the turnip field and lit upon one of the goats and said:

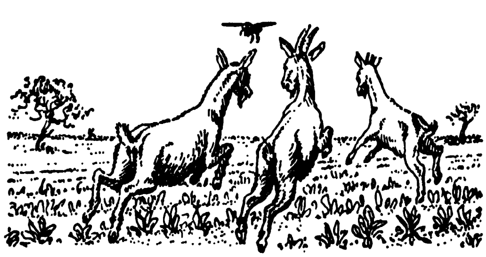
"BUZZ!

BUZZ-Z-Z!

BUZZ-Z-Z-Z!

BUZZ-Z-Z-Z-Z!"

And out ran the goats, every one!



"Buzz! Buzz-z-z! Buzz-z-z-z! Buzz-z-z-z-z!" said the bee. And out ran the goats, every one!

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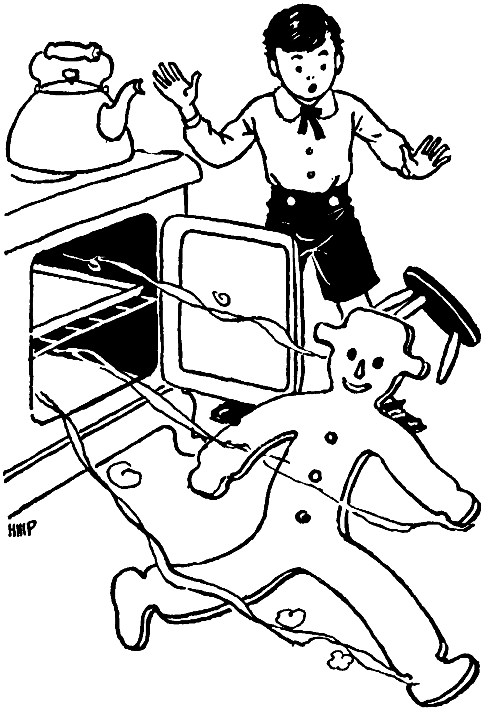
THE STORY OF MR. GINGERBREAD



(An American folk-tale of Colonial times that had its source in the old English tale Mr. Pannycake and the Scotch Wee Bannock. This version is by Margaret Lima Norgaard.)

THERE was once a little boy who lived far off in the country where there were no other little girls or boys, and he was often very lonely.

One day his mother said, "I will bake you a Gingerbread Man, and you can play with him."

So she took flour and molasses and cream and eggs and ginger and baking powder (don't forget the baking powder!), and she mixed them all together and cut out a Gingerbread Man. She gave him round black eyes made of raisins, a funny flat nose made of citron, and a laughing mouth cut out from a wintergreen drop, and she put little red cinnamon candies down the front of his jacket for buttons. Then she laid him carefully in a pan and popped it into the oven.

"Watch him that he doesn't burn," she said to the boy. So he pulled up a stool in front of the oven door, which was made of glass, and he watched,

and he watched,

and he watched.

First he saw the Gingerbread Man begin to grow firm and brown, and then he saw . . . what do you suppose he saw! (You haven't forgotten the baking-powder, have you?) The mother had put in *too much baking-powder!* Now the Gingerbread Man began to rise . . .

and rise . . .

and rise . . .

until he rose right out of the pan—and out of the oven! And before the boy or the mother could catch him, the Gingerbread Man was running out the kitchen door, and down the path, and down the road, as fast as his brown legs could go.

The mother and the boy ran after him, crying, "Stop! Stop, Gingerbread Man! We made you; you belong to us!" But the Gingerbread Man ran on, laughing, and he called back:

> "Run, run, as fast as you can.
> I got out of the oven and out of the pan,
> And you'll never catch this Gingerbread Man."

And the mother and the boy could not catch him, though they ran as fast as ever they could.

The Gingerbread Man ran on and on, through green fields and meadows knee-deep in hay. And he met a cow.

"Stop, Mr. Gingerbread!" said the cow. "Don't run so fast. Bide a bit and let me eat you up."

But the Gingerbread Man only laughed and ran faster, calling back:

> "Run, run, as fast as you can.
> I got out of the oven and out of the pan,
> And *you'll* never catch this Gingerbread Man!"

The cow ran after him as fast as ever she could, but she could not catch him. The Gingerbread Man ran on, and he came to a field where a horse was grazing.

"Stop, Mr. Gingerbread!" cried the horse. "Do not run so fast. Bide a bit and let me eat you up."

But the Gingerbread Man ran faster than ever, leaping high as he crossed the field and he called back:

> "Run, run, as fast as you can!
> Everyone's chasing the Gingerbread Man.
> The boy and the mother, the red bossy-cow;
> So *you* can try to catch me now!"

And the horse ran after him as fast as ever he could, but he could not catch him.

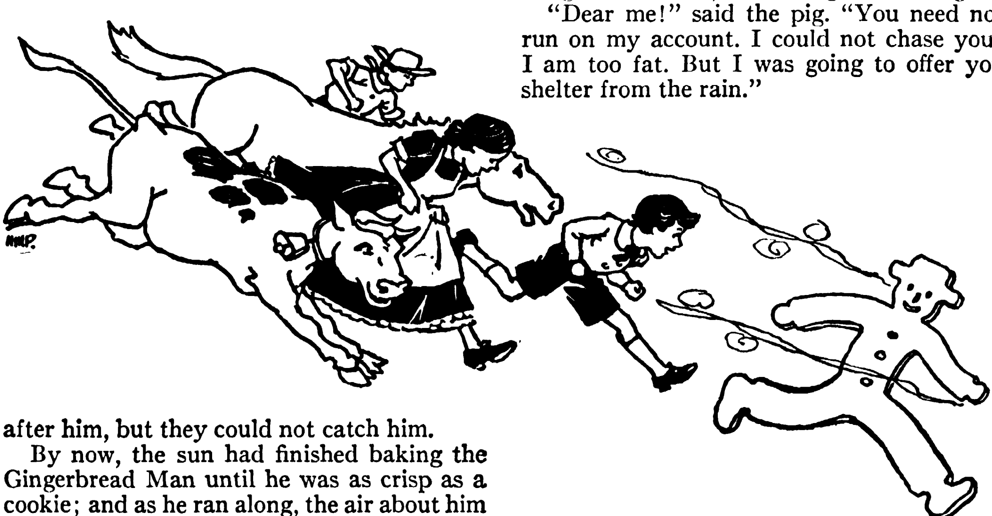
The Gingerbread Man ran on and on, and he came to a farmyard where threshers were at work, separating grain.

"Stop, Mr. Gingerbread!" called the threshers. "Bide a bit and rest a while."

"No, thank you, threshers," said the Gingerbread Man. "I would not rest in your farmyard. You would eat me!" And he ran on past them, calling back when he was safely by:

"Run, run, as fast as you can.
Everyone's chasing the Gingerbread Man.
The boy and the mother, the horse and the cow;
So *you* can try to catch me now."

And all the threshers left their work to run after him, but they could not catch him.



By now, the sun had finished baking the Gingerbread Man until he was as crisp as a cookie; and as he ran along, the air about him was filled with the good smell of ginger and molasses and cinnamon candy. Some woodcutters who were at work in a woods near by, smelled him and they dropped their axes and came running.

"Stop, Mr. Gingerbread!" they called. "Stop and let us have a taste of you!"

But the Gingerbread Man ran out of the woods and into a meadow, calling back:

"Run, run, as fast as you can.
Everyone's chasing the Gingerbread Man!
The boy and the mother, the horse and the cow,
And the threshers. So *you* try to catch me now!"

And the woodcutters could not catch him.

Now the Gingerbread Man felt proud of himself. He began to dance and prance and caper among the daisies of the meadow. Surely no one would ever catch him.

And no one ever did! But someone finally ate the Gingerbread Man. It was someone who never ran after him at all, who never even tried to catch him! For, listen—as the Gingerbread Man danced and skipped along, thinking himself so smart, a drop of rain fell on his crisp brown jacket. He looked up at the sky, and there he could see no sun at all, only dark clouds. He was frightened, because he knew that rain would make him soft and soggy, and then he would be caught by the mother and the boy and the horse and the cow and the threshers and the woodcutters, all running after him.

Then out of the woods came a pig.

"Good day, Mr. Gingerbread," said the pig.

"The same to you, Piggy Wiggy," said the Gingerbread Man, and he began to run again.

"Dear me!" said the pig. "You need not run on my account. I could not chase you; I am too fat. But I was going to offer you shelter from the rain."

The Gingerbread Man thought that might be a good idea.

"Seat yourself on my back," said the pig, "and you will not get your feet wet."

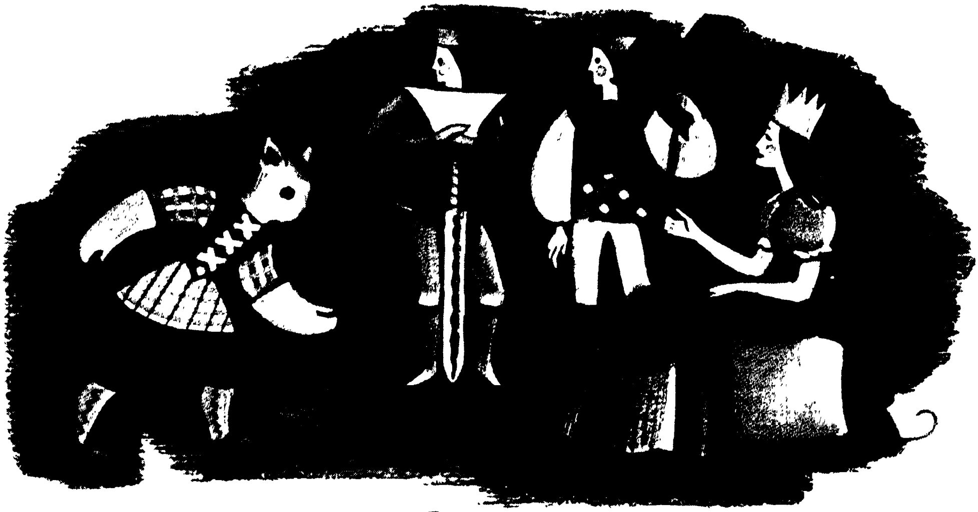
So the Gingerbread Man did that, but the pig's back was too round and rolly.

"Seat yourself on my snout, then," said the pig.

So the silly Gingerbread Man did that, too, and then—"Oink! Oink!" grunted the pig, and he gave a great twitch to his snout, and down tumbled the Gingerbread Man right into the pig's mouth! And the pig swallowed him up at a gulp.

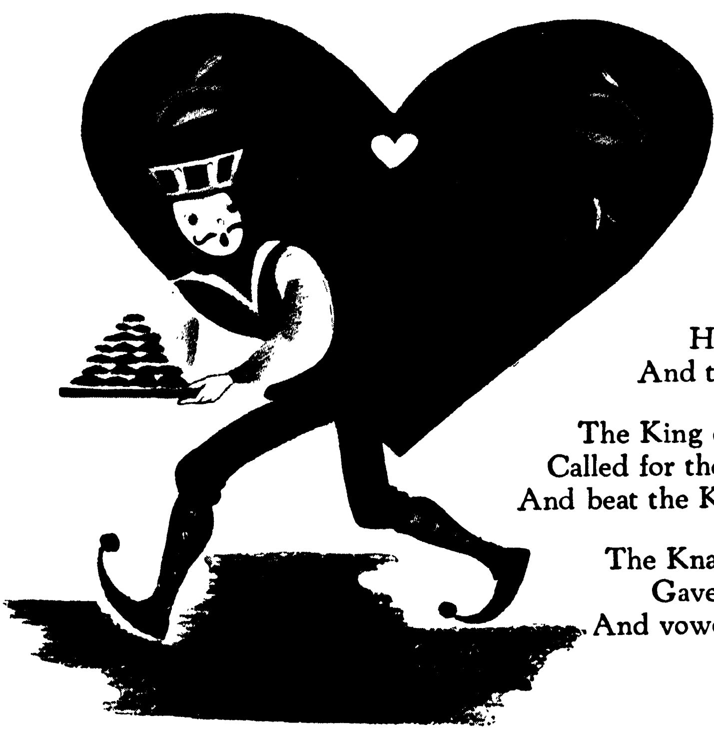
And so, as that was the end of the Gingerbread Man, why this must be the end of the story.

THE NEXT READ ALOUD STORIES ARE ON PAGE 4192.



Pussy-Cat Pussy-Cat

Pussy-cat, pussy-cat, where have you been?
I've been to London to visit the Queen.
Pussy-cat, pussy-cat, what did you there?
I frightened a little mouse under the chair.



The Knave of Hearts

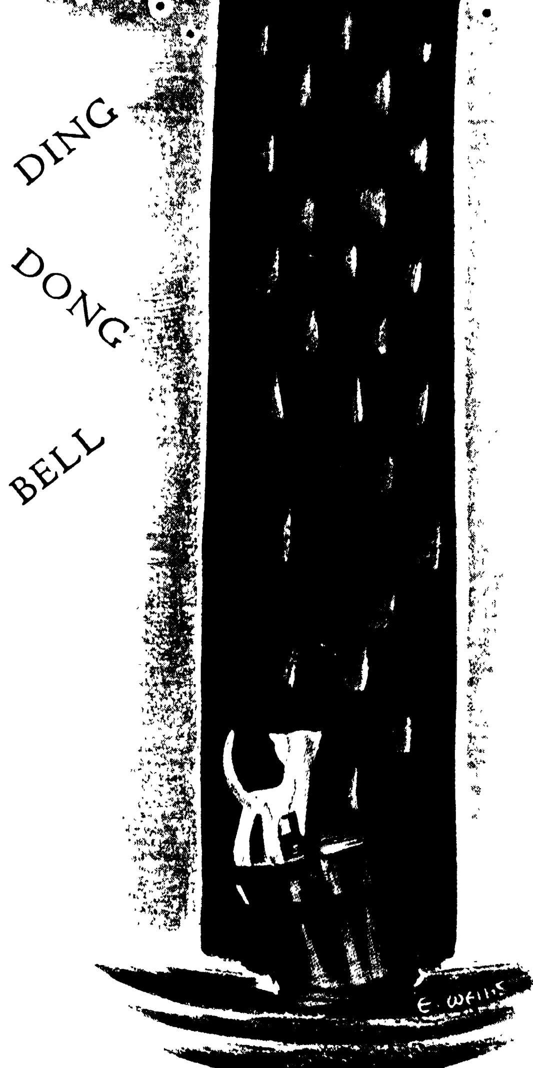
The Queen of Hearts
She made some tarts
All on a summer's day;

The Knave of Hearts
He stole those tarts
And took them right away.

The King of Hearts
Called for those tarts
And beat the Knave full sore;

The Knave of Hearts
Gave back the tarts
And vowed he'd steal no more.

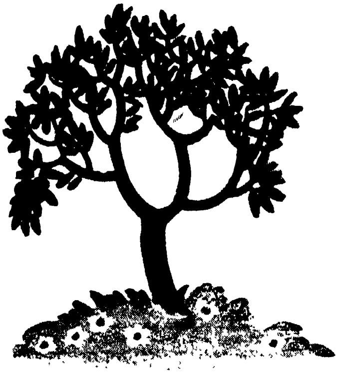
DING DONG BELL



Ding, dong, bell
Pussy's in the well!
Who put her in?
Little Johnny Green.
Who pulled her out?
Little Johnny Stout.
What a naughty boy was that
To try to drown poor pussy-cat,
Who never did him any harm,
But killed the mice in
his father's barn!

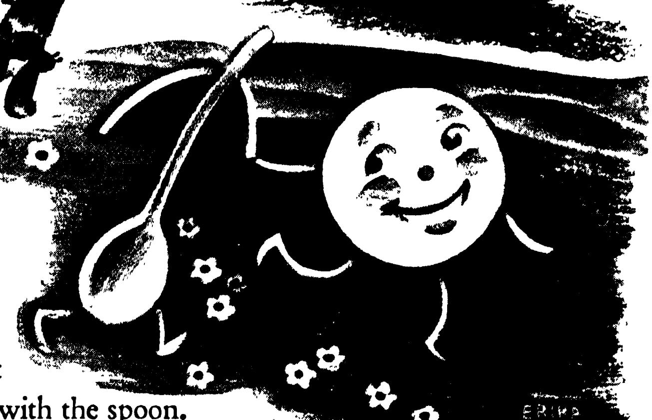
Elizabeth, Elspeth, Betsy and Bess

Elizabeth, Elspeth, Betsy and Bess,
They all went together
to seek a bird's nest.
They found a bird's nest
with five eggs in it,
They all took one, and left four in it.



I had a little nut tree,
nothing would it bear,
But a silver nutmeg, and a golden pear.
The King of Spain's daughter came to visit me,
And all was because of my little nut tree.
I skipped over water, I danced over sea,
And all the birds in the air
could not catch me.

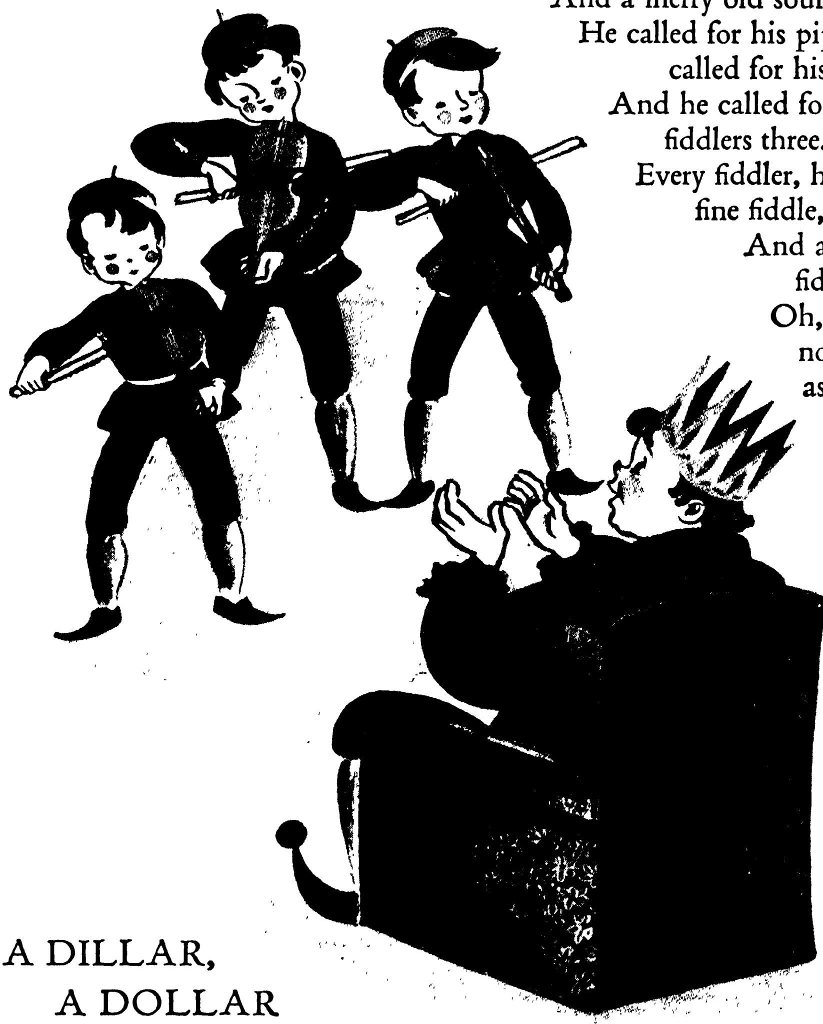
Hey diddle diddle!



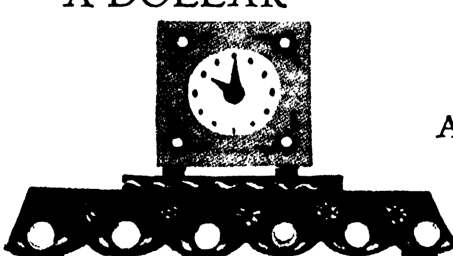
The cat and the fiddle
The cow jumped over
the moon:
The little dog laughed
to see such sport
And the dish ran away with the spoon.

OLD KING COLE

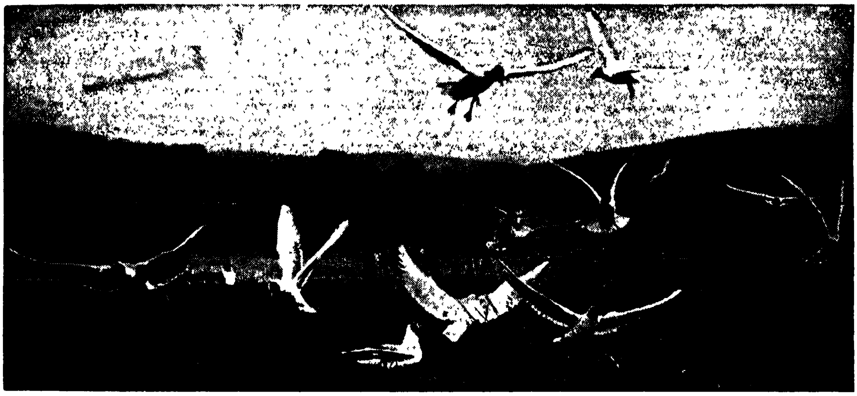
Old King Cole was a merry old soul,
And a merry old soul was he.
He called for his pipe, and he
called for his bowl,
And he called for his
fiddlers three.
Every fiddler, he had a
fine fiddle,
And a very fine
fiddle had he.
Oh, there's
none so fair
as can compare
with
King Cole
and his
fiddlers three.



A DILLAR, A DOLLAR



A dillar, a dollar, a ten-o'clock scholar,
What makes you come so soon?
You used to come at ten o'clock,
And now you come at noon.



Black-headed gulls alighting.

SEA BIRDS AND THEIR INLAND KIN

THE Drakes and Raleighs of the bird world are the Terns. As those sturdy adventurers "roamed the world about," fearless and free, but were drawn back after long wanderings by the lure of home in the land that sent them forth, so these seafaring birds make light of journeys wide as the world.

It is believed that the Arctic Tern may sometimes travel upward of 22,000 miles in a year. There is nothing of witchcraft, nothing of spells or charms, in the enterprises of the bird. Its brain and its stout little heart bear it north as far as it can find land for nesting in the Arctic spring, and carry it south as far as it can find open water for feeding in the Antarctic summer, though most individuals winter north of the Equator.

That seems, if one considers, the most heroic endeavor in nature, for the bird is so small. In spite of its long swallow-like tail and the spread of its pearly wings, its body is insignificant in bulk. It is amazing that so small a mass of tissue can provide the sustained energy necessary for this tremendous flight.

One part of the secret is that the bird is a fish-eater; and, with open ocean always beneath it for the great flight, it has an unending dinner-table spread, beckoning it to food whenever appetite grows urgent. Still, we must marvel at a system of adjustment and accommodation which enables this bird to pass from the home of lasting ice and snow through the heat of the tropics unharmed and unwearied.

Not all of the more than fifty species of tern fly the same distance as this species. The Common Tern, to be distinguished from the all-red-beaked Arctic Tern by the black tip to its crimson bill, has its northernmost nesting limit at the most southerly boundary of the Arctic bird's range, and is commoner to the South than to the North; whereas the Arctic Tern is thinly represented south of the Arctic Circle, but swarms beyond it.

Some of the terns avoid the seacoast for nesting, and like the marsh terns, of which there are three European species, cradle their eggs on tussocks of grass or among floating vegetation in marshes. Our Black Tern has the same habit. For the most part, however, the terns, when undisturbed by the presence of man, have their nurseries by the sea, in receptacles scooped out among the pebbles, which the eggs themselves resemble.

North America has about fifteen species of terns, though some, like the Common, the Gull-billed, the Caspian, the Arctic, the Roseate, the Royal and the Sandwich, also inhabit the Old World. On the other hand, we have a little beauty, the Least Tern, which is not over nine inches long. It is sometimes called the Silvery Tern.

So swift and shifting are their aerial movements that we call them sea-swallows. Much of the beauty of the family is lavished on the terns, and their splendid flight, their magnificent dives from the wing into the water for fish, the affectionate sympathy they show in collecting round a wounded comrade, make them among the best-loved birds of our shores.

THE AMAZING SKILL OF THE NODDIES IN FINDING THEIR WAY AT SEA

Warm islands of the Atlantic and Pacific shelter a related, but slightly larger, form in the Noddies, birds not so adventurous in flight as the terns, though amazingly skilled in finding their way home over hundreds of miles of unknown sea, across which they have been carried in the darkness of captivity. They have had so little experience of men in the past that they tolerate our near approach to their nests and permit themselves to be caught when they alight on ships. So travelers who knew the ways of sailors with birds called these trustful ones what they seem—noddies or noodles.

From the same family stock as these there has arisen a notable example of specialization in the beak of the Skimmers, birds known to American, Indian and Red Sea waters. Our species is called the Black Skimmer, though it is white underneath. The bird in general outline is a large tern, but the upper part of the beak is much shorter than the lower.

The purpose of this great development of the lower mandible is seen as the bird, with splendid power of wing, skims just above the surface with the under half of the bill scooping the water, or the oozy bed of the sea at low tide on the shore, and even the muddy shallows of the Nile estuary. The beak picks up food as the tube of an express engine picks up water from the long trough between the rails as the train speeds on its way. This bird, which is also called the Cut-water and the Scissorbill, is now seldom seen farther north than the coast of New Jersey.

THE BEAK OF THE GULL THAT CAN TEAR LIKE AN EAGLE'S

The Gulls have no such peculiarity. They are superbly competent birds, and the fact that the arrangement of the beak with them is the reverse of that in the skimmer is an asset. The gull bill is longer in the upper than the lower half; only a little, but sufficient to furnish a hook to the superior half—and that hook can rip as fiercely as an eagle's.

They are scattered round the shores of all the seas, and till the fuel oil from our modern ships began to pollute our waters, whoever saw the gull tribe saw a tribe most prosperous. The gull is as adaptable to widely differing conditions as a rat or a sparrow; as clever and as ruthless.

Cliffs, rocks, lone marshy moors and trees are safe abiding places for the nests in which gull eggs turn to squawking babies. Fifty species and more there are of the better-known sorts, in addition to exotic types found only in restricted areas. We have about fifteen of them, but can glance at only a few.

One of the most fascinating is the Glaucous Gull, a giant nearly a yard long, coming down to rest with us for a breathing space as he wings his way south from the wild Arctic, where he has reared his babes. The Black-headed, or Laughing, Gull is common in Europe as well as in America. It is white-headed in winter and assumes its rich ebony mantle only in the spring, when love summons it to its finest apparel.

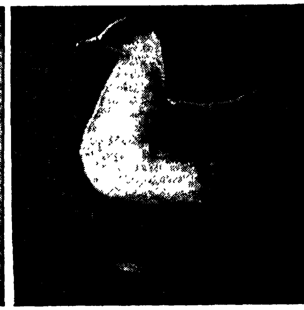
SOME OF THE OTHER SPECIES OF GULLS

Another that we see often in the fields is that pearly-bodied, yellow-billed fisher of the shallow seas, the Herring Gull, which finds, however, an increasing harvest in our fields, to our very great advantage. The European form is smaller than ours. Then there are the Great Black-backed Gull, thirty inches long, and that wonder of plumage, the Ivory Gull, whose feathers, in their creamy purity and enamel-like sheen, make it one of the most beautiful of a beautiful family of birds. We must not omit the Kittiwake, with white head and neck, gray mouth and white-tipped wings. It is also found in Europe. Then, too, there is Bonaparte's Gull, only a little larger than the Least Gull of Europe. Franklin's Gull is a resident of the interior plains.

THE GRACEFUL GULLS AND THEIR COUSINS

The herring gull.

The great black-backed gull.

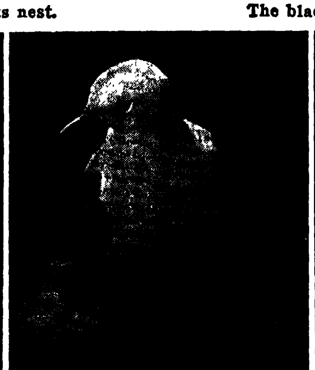


Parasitic jaeger.

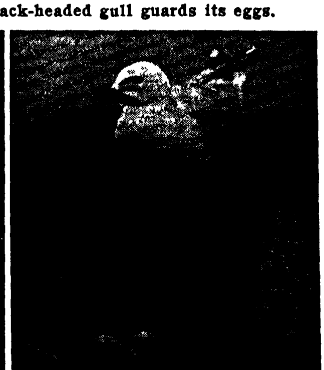
The Arctic tern alights at its nest.

The black-headed gull guards its eggs.

McCormick's Anarctic skua.



The kittiwake.



The common gull.

THE GOOD WORK THE GULLS DO FOR US ALL

In our ports the gulls earn their keep as a delightful free aviary; in the country and by the sea they take their keep and merit it for services unacknowledged, though the fishermen cry out that gulls rob them of their fish, and farmers complain that gulls take their grain. So far from depleting our fishermen's earnings, they call the fleet to the herring shoals, and the fish they take can well be spared. They are the flying beacons to summon us to the fish, they are the unpaid guardians of our sailors in little boats drifting, but for the warning cries of the gulls, on to lee shores in fog.

What of the grain-eating? There is some truth in it, but tests extending over seven months failed to discover proof, while finding that the birds ate enormous numbers of insect enemies of our crops. Examination of gull crops shows that these birds devour the enemy wholesale. Careful calculations proved that the gulls each eat at the rate of twenty-eight thousand insects a week, to say nothing of the myriads of eggs from the perfect insects also taken. And, as hundreds of the birds work together in the hunt, the total must be colossal.

THE DEVOTION OF THE BLACK-BACKED GULL TO ITS YOUNG

The Great Black-backed Gull has an evil reputation for snapping up eggs, young birds and rabbits, and has been known to kill weakly lambs. But much must be forgiven this bird for its splendid devotion as a parent. An evidence of the kind was unexpectedly afforded a naturalist who was fishing recently on the Isle of Skye. Seeing a full-sized young black-backed gull not quite able to fly, he took it home as a pet and put it for safety for the night in a hen coop. The youngster raised its voice in piteous appeal, and lo, an echo answered from the sky, where two great creatures, giving call for call, were seen flying in lower circles, seeking their offspring.

All that night the young gull clamored for deliverance, so in the morning its kindly captor let the bird out of its coop. Hardly had he done so when there was a flash of wings and a great black-back swooped from the air, seized the young one, carried it off, and deposited it in the sea. There the two were presently joined by a third, and all swam away.

THE TERRIBLE WEAPONS OF A PIRATE OF THE AIR

All these gulls are dependent for part of their career on the sea, yet not to the same extent as the pretty and nimble Kittiwake, which covets no aid from man, but swims the inshore waters for its food and finds its lodging on the edges of cliffs nearest the sea.

The creature gulls most fear is, next to man, the Skua, or Jaeger Gull, and the reason is sufficient when skuas are plentiful, which is not now the case. For this sea bird, which attains a length of well over two feet in the great skua, is one of the fiercest of all fliers. It has the powerful hooked beak of a bird of prey; its talons are strong and sharp and viciously used in gripping the prey it tears. It is a pirate wherever it is found.

Superb on the wing, it can overtake the tern and make it disgorge its food. It can kill and devour birds of great size. In defense of its nest it will attack a man, swooping like a hawk at his head, perhaps to use that mighty beak, certainly to attack his eyes with whip-like lashes from the tips of its tremendous wings. One species actually nests as far south as the Antarctic mainland.

Antarctica is a foodless land, yet the skuas find plenty there. They prey on the nesting penguins, steal their eggs, carry off nestlings far heavier than the heaviest skuas, and pick their bones bare. They are as dependent for life on the penguins as a sheep on grass.

A skua's power of offense and defense, its tigerish courage and wanton aggressiveness, render it immune from all bird attacks. How, then, is it that it does not outnumber other birds and become a world-wide scourge? Nature herself supplies the check.

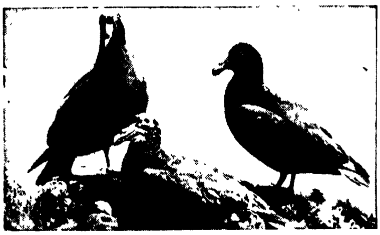
HOW NATURE KEEPS DOWN THE NUMBERS OF THE SKUA

Ferocity is born with the breath of life in a baby skua. The nestlings fight to the death in their cradles. The victorious little murderer survives, triumphant over its slaughtered brothers and sisters. By that process of elimination skua numbers are kept down, and only the most efficient little ruffian emerges from the cradle to carry on the species.

Many a meal in northern latitudes comes to the skuas from the next family, the Auks, which includes the Auks proper, Murres, Guillemots and Puffins.

QUAINT AND BEAUTIFUL BIRDS OF THE SEA

The beautiful albatross in flight over the sea.



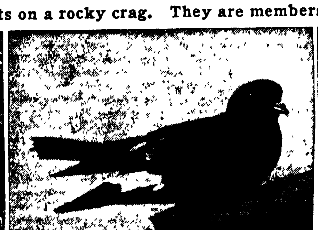
Giant petrels.

The razor-bill.

A group of puffins.

A colony of guillemots on a rocky crag. They are members of the auk family.

The Manx shearwater.



The stormy petrel.

The Fulmar petrel.

The pictures on these pages are by Messrs. Mortimer Batten, Berridge, Brook, Chislett, King, Kirk, Lodge, Herbert G. Ponting, Roberts, Seth-Smith, and others.

The Razor-billed Auk interests us as the closest surviving link with the great auk, once enormously numerous, but which has been exterminated in modern times by brutal seagoers, who mowed it down on its island homes as gardeners mow down the grass of a lawn.

The razor-bills will survive because they have fine wing power. They and the guillemots keep the sea, save for nesting times, and fish for herring and other small fish. The Little Auks dwell in the north, as we have noted, and well they fare there.

THE LITTLE AUKS THAT PEARY'S MEN CAUGHT IN THE ARCTIC

When Peary was making his successful journey to the North Pole some of his men sat wrapped in furs, hour after hour, on one of Greenland's icy mountains, netting little auks as they streamed home, thousands and thousands strong, from their fishing. The white men let their little victims go, but the Eskimos, counting on the birds for food, net them at night like butterflies as they fly.

There is a memorable picture, too, of a rather earlier day of the little auks in a Spitzbergen bay. They extended across the water in an unbroken line more than three miles long. A calculation made at the time showed that there must have been over four million little auks. Yet the little auk lays but one egg a year, in place of the ten or twenty of the partridge. We know from this that little auks can take care of themselves, and that they are very long-lived birds.

Another auk, and the strangest, is the Puffin, or Sea-parrot, a grotesque little bird which, in the nesting season, wears a huge many-colored beak. The outer sheath is shed in winter. Probably the development is related to the unique habit of the puffin when foraging for its young. It catches little fishes, one after another, and arranges all in symmetrical order in its beak. How it can keep number nine in place when it is catching number ten we cannot guess. But there are more wonders in bird structure and method than we have yet solved; one has heard a blackbird whistle cheerily to its nesting mate when its mouth was stuffed with worms! On the Pacific coast we find the Tufted Puffin, which is similar except for two tufts of yellow feathers above the eyes. The Large-billed Puffin breeds only in the Far North.

THE WONDER OF THE SILENT FLIGHT OF THE ALBATROSS

Our next step leads us to a family of birds in which another unique feature is a guide to classification: the nostrils take the form of tubes lying along the surface of the beak. They are great fliers all, sea birds in the truest sense, dependent on land only for nesting sites.

Chief of the family is the Albatross, the wonder bird of the ocean; light of body, narrow of wing, but with those great living sails, or propellers ten or twelve feet, or even more, from tip to tip. The ocean is their kingdom. They fly unweariedly day after day, night after night, hundreds and hundreds of miles with the fastest steamer, sailing round and round her with such marvelous skill of wing that for ages the secret of their flight has been debated.

Many watchers have believed that the sailing is effected with stationary wings on unperceived currents of favoring air. But the truth is that the albatross adjusts its great wings to match its needs in the air, just as an airman contrives his balance in an airplane. The camera will settle the problem for all time one of these days, but already we know that a flicker, a swift rise or down beat are among the bird's master strokes in aviation. The flight of these birds seems effortless; the truth is Nature has given the albatross a mastery of the art of conserving energy, and its flight is the marvel and despair of every man who contrives to rise by artificial method into the air. Though this bird is found chiefly in the southern ocean, occasional specimens are seen in northern waters.

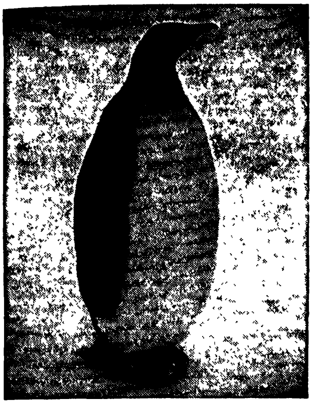
Another great flier is the Giant Petrel, a thirty-two-inch bird which plays the vulture at sea, gorging itself on carrion till it can no longer rise from the water, but must swim itself back to efficiency. The Fulmar Petrel is a related species, smaller, but equally notable on the wing.

A BIRD OF THE SEA THAT MAKES A BURROW ON LAND

As devoted children of the ocean are the Shearwaters, so called from their habit of skimming just above the surface in quest of food. When they come to land they turn cave-dwellers, but their caves are of their own making, burrows neatly excavated in the soil.

They seem, as they skim the water with feet paddling the waves, to be running

THE FLIGHTLESS BIRDS OF THE SOUTH



The emperor penguin.

An Adelie penguin and young.

The rockhopper penguin.

Adelie penguins sunning themselves at Cape Royds, in Antarctica.

A king penguin and a Gentu penguin.

A group of black-footed penguins.

actually on the surface, so they and the group to which they belong are all called Petrels, in allusion to St. Peter's walking on the Sea of Galilee. Most famous of the petrels is the Stormy Petrel, a delightful little mariner which seems happiest when great billows rage and storm winds blow. The presumption is that the churning seas bring up the food it seeks. The wash created by a steamer has the same effect, and so lures these dainty beauties on long, unflagging pursuit of the vessels which carry men and merchandise across the ocean. They are sometimes called Mother Carey's Chickens.

And now, as in a transformation scene, we pass suddenly from power of navigation in air and water to a strange assembly of birds that do not fly at all, yet are master mariners and landsmen of the first magnitude. The Penguins, of course, are the birds in question, birds which once had wings and flew.

WINGLESS BIRDS OF THE SOUTH THAT LIVE AMID SNOW AND ICE

About fifteen species of penguins exist to-day, all in the southern half of the world, in parts of South America, Australia and New Zealand, and on many islands of the south Pacific. The Emperor Penguin, largest of all, lands for the winter on the Antarctic ice, while the Adelie Penguin spends the summer there, but sails north with the ice pack before darkness and winter cover the tragic land.

All penguins have an upright gait on land, except when, to relieve the strain on nerve and muscle, they bring their breasts flat on smooth ice or snow, and toboggan, kicking themselves along with their stout little webbed feet, like boys pushing sledges before them.

At sea they swim superbly, as much under the water as on it. They work down to the bottom in search of fish and crustaceans, and sometimes bring up stones and pieces of coral in sport. But another method is known as porpoising. With flippers used as oars they make a dash beneath the water, then rise suddenly and leap into the air, with bodies bent forward, and progress in a series of rapid curves, first in and through the water, then up and above its surface, all at top speed, so that they are mistaken for small examples of the mammals they imitate so perfectly.

In most places they march out of the sea on land, like two-legged animals, and the black volcanic rock of the Falkland Island coast is deeply scored where for ages and ages millions of penguins have climbed their way inland. One species uses the tips of its flippers as legs and runs along on all fours, like a mammal. But the most wonderful method of getting to land is that of the Adelie penguins as they go ashore for their summer nesting.

HOW THE ADELIE PENGUIN LEAPS FROM SEA TO SHORE

They have an ice-foot to scale, for there are only certain parts of the continent to which they can go. These are the bleakest parts, swept bare of snow by the gales, so that they may have clear spaces for their nests. They survey the position from the sea and mark a landing-place unerringly.

Then they dive down beneath the surface, get a tremendous kick-off in the sea, and rise from it like a cork popping out of a bottle. With such a leap they clear the water and jump ten feet forward and four or five feet straight up on to the ice, all done in a second, after one momentary glance at the landing-place chosen.

Hundreds of thousands of penguins assemble in Antarctica in this way, arriving singly, in couples, in droves. They make nests by building up stones, and lay their eggs there, one or two, without any other protection than that afforded by their own bodies. And the marvel is that the birds, with the tremendous tax on their strength implied by egg-laying and brooding of the eggs, fast for a full month and more—an amazing exception to the rule that birds must eat often and heartily.

At the end of a month one bird will go down to the sea to feed, and then he will return and relieve his mate, who in turn will be absent for a fortnight while the male takes duty. When the chicks are hatched, the parent birds go in turn to feed, and return bulging with food so that they can barely walk and have to balance their protruding little stomachs by carrying the head far back.

All is simple so long as the nestlings are helpless, but when they can run, they do, popping off at a moment's notice. So, as both birds now have to go together to bring back food, nestlings from a number of nests are gathered together under the joint protection of many penguins, and apparently the parents returning to this communal nursery identify and feed their own babes.

The Adelie penguins go back to sea with their babes full-fledged when summer is ending, first teaching the reluctant and cowardly youngsters the main business of their lives, to swim. As the Adelies go out the Emperors come in. Theirs is the strangest existence in all the world.

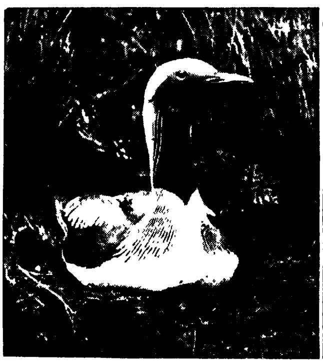
They have the most desolate, cold, appalling nursery ever imagined. The young ones take many months to attain feathers and maturity; therefore they must have the full summer before them for the process, so their parents have to endure the agony and horror of nesting through the long winter night.

The parent birds establish themselves on the ice with a temperature of perhaps 100° and more of frost. One egg is laid, and, there being no nesting material, it is balanced on the upper side of the bird's feet and pressed there by a fold of skin on the lower part of the body. So great is the parental passion of these extraordinary birds that they fight for each other's eggs; they take up stones and pieces of ice and seek to incubate these; and when the chick is born scores scramble to nurse it. The greater part of the emperor chicks are killed by kindness, being trampled to death by eager competitors for the honor of keeping it alive.

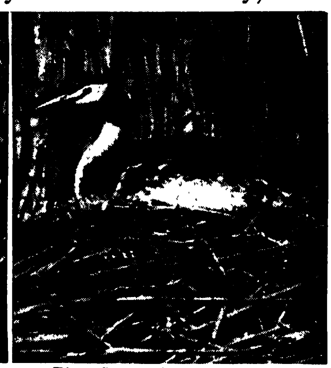
Examinations of emperor rookeries have shown that three-fourths of the little ones perish in the same way. So emperor penguins are never abundant, yet never in danger of dying out, so remote is their breeding-place. They attain considerable size, forty-two inches in height and with a weight of ninety pounds. Many an Antarctic explorer has owed his life to flesh obtained from their plump bodies. Nevertheless, no man of feeling likes to kill a penguin.

The birds seem almost human in some of their instincts. They have the most courtly way of bowing to each other and of holding what seem to be animated conversations. They bow and talk to men in the same way, and when not understood go through the same performance of gesture and speech again, as if in sad contempt for our ignorance.

Among themselves they play like boys. They fight tremendously during the breeding season, but before and after that they are fast friends. At the water-side they romp like children, doing their best to push one another into the water. Once in, they sport with delight, call to those on shore and show the keenest perception of fun. When ice-floes come sailing by on the racing tide they board them and ride in ecstasy to the end of the bay, then slip off, swim back, and go for another happy journey in the same way.


The Black-throated Diver.


The Coot.


The Great Crested Grebe.

Certain features ally the penguins with the Divers, or Loons, and Grebes—birds which in past days had other flightless kindred in the famous old hesperornis whose remains we find in the earth. Their modern representatives are smaller, but fly, swim and dive with power.

Chief of the group is the Common Loon, or Great Northern Diver, whose cousins are the Black-throated and the Red-throated Loons. They generally resort to inland lakes for nesting, but afterward they return to purely oceanic habits. Here they are in their true element. They swim like corks; they dive in a manner unexcelled; and such is the development of their breathing system that they are known to remain under water for eight minutes at a stretch.

These birds are, of course, web-footed, but their kin, the Grebes, have the feet

lobed, with broad flat nails—a modification associated with their habit of keeping more to inland waters and frequenting the land. There are over twenty species, of which we know best the Western Grebe, one of the largest; Holbœll's Grebe, one of the commonest; the Horned Grebe, which has a wonderful growth of feathers about its head in the breeding season; and the beautiful Pied-bill Grebe, or Dabchick. The Great Crested Grebe belongs to the Old World. Its plumage is much sought for millinery purposes.

Finally, we have the Rails, an immense family comprising nearly two hundred species, many with a penguin-like tendency toward loss of flight. One, the Weka Rail of New Zealand, seems equally doomed, for though big wings are there, ability to fly has departed owing to long disuse.

THE CRY OFTEN HEARD OF THE BIRD SELDOM SEEN

The Corncrake is common in Europe, but seldom seen in America. It is a fast runner, but it flies away in autumn to warmer winter lands. The Virginia Rail is very much like the Water Rail of Europe, but is smaller. It is wholly confined to fresh-water marshes and never visits the borders of the sea, and accordingly its haunts are in the interior. Though it migrates to the shores of the St. Lawrence, it is unknown in the far countries of the North, and retires at the first touch of frost to the southern states. The Sora Rail of the southern states is much like the Dotterel of Europe.

Next we must mention the closely related Gallinules. The Common Gallinule of Europe is often called the Moorhen. At the coming of danger it submerges silently in the water, and one sees apparently a little autumn-tinted leaf floating where a big bird was a moment before. That leaf is really the bill of the moorhen, its periscope, through which it breathes, generally undetected. The Florida Gallinule occasionally nests as far north as southern Canada. It is a slate-colored bird, with yellow legs, long toes and red bill. In South America it extends over a great portion of the continent, frequenting pools, lagoons and streams. It makes its clumsy bed of reeds in a swamp or marsh on a dry knoll, or occasionally hanging in flags or rushes over water. You would find no music in its voice, although it is deep. Shy and retiring in its habits, it leaves its marshy haunts only when it is time to migrate, and then it steals off under cover of darkness. On the wing it looks very awkward, but when walking or swimming it is noticeably graceful! The Purple Gallinule is similar, except in color, but prefers the warmer regions. It is a beautiful bird; its back a bright olive, its wings deeper green shading off to blue, and its head, neck and breast purple. When in the southern states the purple gallinule lives in rice-fields and fresh-water pools. In its native marshes of the North it is shy and vigilant and can be flushed only with the help of a dog. If irritated, this bird will bite hard; it can run swiftly, and holds on to objects very firmly with its long, spread toes. Its favorite food is a mixture of water-snails and plantains.

The Coot, which is larger and plumper, with a white patch, instead of a red, over the base of the beak, keeps more to the water than its cousins, and is a treasure of quiet overgrown streams and marshy waters. It deserves honorable mention in any list of clever birds, for when attacked by a bird of prey Master Coot collects all his family and friends, and by means of wings and feet they all set up such a shower of water that the enemy is drenched and in danger of falling helpless into the stream and drowning. So victory rests with the weaker, wiser little coot.

THE SHY LITTLE FINFOOT THAT GROWLS LIKE A FIERCE WILD BEAST

The coot's foot is grebe-like as regards the lobe of the toes. The toes of the Finfeet are clad with broad scalloped webs, and have claws sharp enough to make the hand that catches them bleed smartly for its daring. The finfeet are shy birds, peculiar to tropical South America and parts of Africa and south-east Asia. Perched like kingfishers on rock or bough above a stream, they launch themselves in a lightning dive into the water on any living thing which moves below in such a manner as to suggest a meal.

The finfoot has a habit of filling himself with air and then exhaling it so noisily that he sounds like a fierce animal growling. In that he has the ostrich for a master, a bird whose roar deceives even experienced hunters into mistaking him for a lion. Doubtless the finfoot would like to be mistaken for such a beast.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 4283.

Australian News & Information Bureau

An expert thrower of Australia prepares to show his skill with boomerangs that have an especially sharp curve.

WHY DOES A BOOMERANG COME BACK?

SOME people suppose that the boomerang comes back after hitting what it is aimed at. That would really be very convenient, but it is not what happens. What happens is this.

The first part of the boomerang's path is straight, or practically straight. It is expected to hit its object while it is in this part of its path. If the boomerang were flying through nothing, it would have to fly always in a straight line, according to Newton's first law of motion, which states that when a thing is moving, it will go on moving at a steady rate and in a straight line unless something outside it changes its motion.

But the boomerang is flying through air, which slows it down; and it is so shaped that the air resists one part of it more than another, so that it has to travel in a curved path after its speed has slowed down below a certain rate. As it travels in a curve, it more or less comes back to the place it started from.

Endless study has been devoted to finding why the boomerang must have its exact shape; what the consequences are if its shape is a little different; what the speed is at which it begins to curve; how its weight and size affect the curve; and what the relation is between the curves of the boomerang itself and the size of the curve it makes in the air. But these questions are immensely difficult, and still undecided. If the boomerang, instead of being gradually slowed down, is arrested entirely in its flight, it simply drops dead, as we say. If it is to return, it must

be slowed down by the resisting air.

The stories about Australian aborigines being able to throw a boomerang so that it will kill an enemy hiding behind a tree and then return to the sender, or of a native throwing the boomerang with his back to the object he wishes to hit, are mere Old World fables. It is true, however, that an Australian native who is an expert thrower can cause a boomerang to pass behind him after a short preliminary flight in front.

There are various forms of the boomerang; heavy throwing sticks for fighting at close quarters, and lighter ones for hurling at game at a distance. The boomerangs that return to the thrower—the kind best known to us—are often called play boomerangs; and the Australian aborigines practice throwing these to show their skill. Such boomerangs always consist of a flattened curved blade, usually quite flat on one side and slightly rounded on the other, and the power of returning seems to be associated with a very slight twist in the weapon. A skillful thrower can make a boomerang describe first a large circle and then one or two smaller circles before it falls at his feet. These return boomerangs, contrary to general belief, are found only in very restricted areas of Australia. Weapons similar to the boomerang, but unable to return, were used in ancient Egypt and by Hopi Indians in Arizona.

WHY DOES A FALLING OBJECT TURN ROUND?

A falling thing turns round because a turning motion is given to it when it begins to fall, or by air currents. If we dropped a ball in such a way that every part of it was let go at exactly the same moment, it would probably not turn round. But almost always, when anything is let fall, a turning motion is given to it, just as it is given to a rifle bullet, and it goes on turning. Even when this does not happen, an object may be so shaped that one part offers more resistance to the air than another. That part will be retarded as the object falls, and so it will acquire a turning motion. This turning affects the flight of anything through the air, and in the case of a ball it affects the way it bounces. In hitting a tennis ball we try to put a twist on it, and this may make it swerve in a curious line.

WHY ARE WE THROWN FORWARD WHEN THE TRAIN STOPS SUDDENLY?

Newton's first law of motion tells us that every body continues in its state of rest, or of uniform motion in a straight line, except in so far as it is compelled by force to change that state. While a train is moving we are in a state of motion, and when the train stops suddenly we must, according to the first law of motion, continue moving unless some force hinders us. Our motion forward makes it seem as if we are thrown forward.

If we are standing in a railway car when the train stops, the weight on our feet presses them against the floor and prevents them from continuing their forward motion; but there is nothing except the voluntary force of the muscles to prevent the forward motion of the rest of the body, and so we tend to fall.

When we know the train is about to stop we can brace ourselves, that is, we can apply a force against the forward motion. Then we do not have the feeling of being thrown.

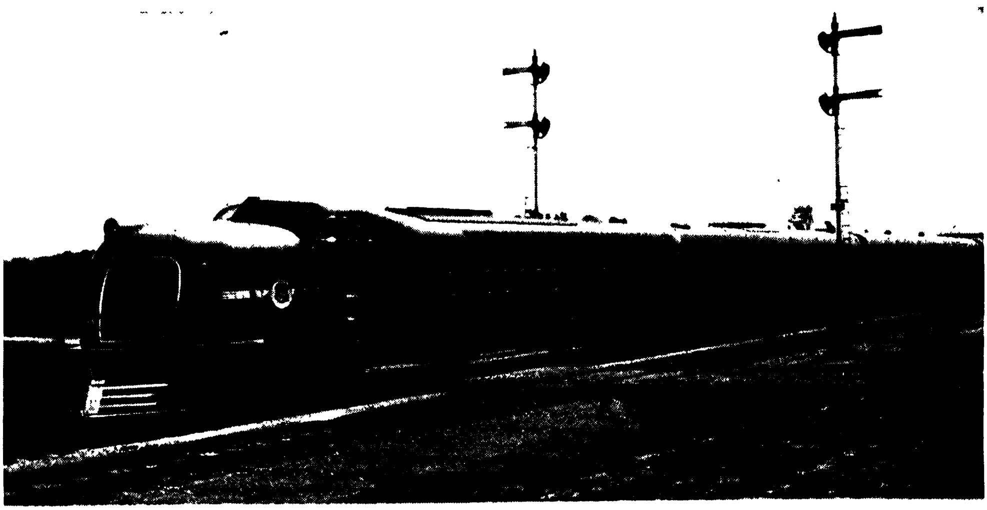
WHAT DOES "STREAMLINED" MEAN?

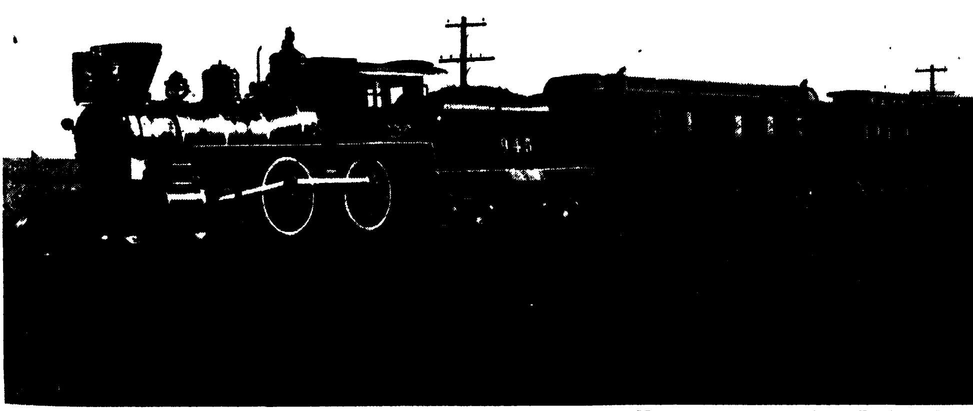
Although we can not see the air, it has substance just as surely as iron or wood. Anyone who has ever seen a tree uprooted in a storm needs no further proof that air can exert great force. Even when still, the air always offers a certain resistance to objects moving through it. In order to move in the air at all, an object must push the air in front of it out of the way. This pushed-away air must somehow find its way around the object. If the object has sharp corners or pieces sticking out from it, the air, flowing around, will form little whirlpools or eddies. If the object is rounded, the air will flow around it more smoothly. A ball has less "air resistance" than a book of the same size.

It has been found that objects move through fluids with the least resistance when their surfaces are molded in smooth rounded lines. These lines are called streamlines.

At slow speeds air resistance is slight, but it becomes much greater at high speeds. The body of a bird has streamlines and this aids its graceful, easy flight. Airplanes must be perfectly streamlined unless most of their power is to be wasted in overcoming air resistance. Automobiles and trains are streamlined, too, to improve their efficiency and appearance.

Streamlining applies to all fluids—water as





Harold M. Lambert from Frederic Lewis

The streamlined train (top) is a smoothly continuous unit, without any projections or angles. As it moves, the air flows around it and is pushed out of the way with little effort. The old-fashioned train wasted considerable power in overcoming the resistance of the air, which whirled around every sharp corner and the space between cars.

well as air. Fishes are naturally streamlined and ships have always followed their lines very closely.

WHEN I WALK IN A MOVING TRAIN DO I MOVE FASTER THAN THE TRAIN?

The answer to the question is yes, if you are walking in the direction in which the train is going. But if you are walking from the front of the train to the back, then you are moving more slowly than the train. There can be no doubt about it, for you can prove it by trying.

If two of you got into the back of the train when it started, and one of you walked right through the train to the front, then when the train stopped, he would get out on the platform much farther forward than the other. He would have traveled farther in the same time than his friend, and farther than the part of the train his friend was in, and thus farther than any part of the train. He has added his own movement compared with that of the train to the movement of the train compared with that of the earth.

The earth is moving too, and if the train is moving on the earth in the same direction as the earth is moving, then the train is moving faster than the earth. And if you are walking from the back of the train to the front, you are traveling faster than the train, and still faster than the earth. And if a fly is walking across your cheek from your ear to your nose, it is traveling faster than you, or the train, or the earth!

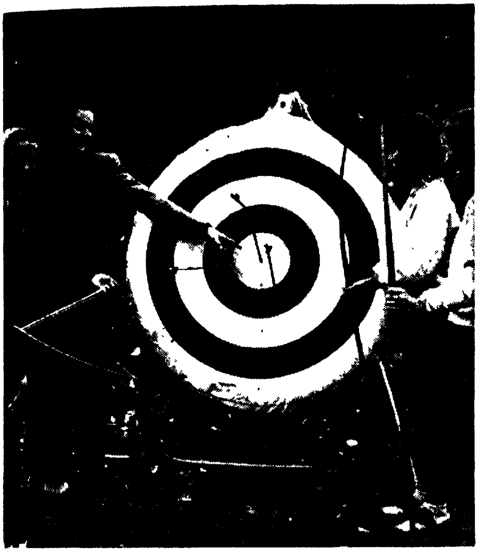
WHAT MAKES AN ARROW FLY?

The motion of the arrow through the air is a kind of power. It was not in the arrow when it lay in the quiver, nor even when it was put in the bow; but when the cord was released and pushed the arrow forward the arrow got its power of motion.

The power, then, came from the stretching of the bow; for if the bow were not stretched

Edward B. Miller from the National Recreation Association

The force that will send the arrow flying to its mark is in the muscles of the archer's arms. It takes considerable strength to pull the bowstring back far enough to bring the whole length of the arrow inside the bow.



National Recreation Association

Bull's-eye! One of these young archers has made a perfect hit, exactly in the center of the target.

it would not drive the arrow; and so, if we trace the power backward, we find it came from the strong muscles of the archer who bent the bow. When the cord and the bow are bent out of their natural shape by being stretched, they carry in themselves, ready to act, the power they have got from the muscles of the archer.

CAN AN IRRESISTIBLE CANNON BALL KNOCK DOWN AN IMMOVABLE POST?

This is like many other questions that people puzzle themselves over, even grown-up people, who ought to know better. It is a question that can not be answered, for the very good reason that it is a question that can not be seriously asked by anyone who thinks. A wise man has said that one of the great things wisdom does for us is to teach us how to ask questions, and wisdom certainly teaches us not to ask silly questions like this. Do we not see that the irresistible cannon ball and the immovable post can not exist together? When we say *irresistible* cannon ball, that is as good as saying that there is no post that can resist it. When we say *immovable* post, that is as good as saying that there is no cannon ball that can knock it down. If either of these things exists, then the other can not exist. And so, of course, there is no answer to the question, What would happen if they existed together? The proposition is an impossibility.

WHAT DO WE MEAN BY A GRAND JURY?

When indictments or formal complaints are returned by the public prosecutor against persons accused of wrong-doing, these complaints are laid before the grand jury, a body of men drawn from the judicial district in which the crimes were committed. The grand jury (numbering from 12 to 23 in the United States) is so called because it has generally more members than the trial jury (also called the petit or small jury). If at least 12 members of the grand jury decide that the evidence is sufficiently strong, a true bill is returned and the accused must stand trial before a trial jury. Otherwise suspects are released. The grand jury is also empowered to report on conditions that require correction. This type of report, not based on indictments, is called a presentment; it has been found useful in exposing corruption in government.

WHAT IS CIRCUMSTANTIAL EVIDENCE?

You may read in a paper that a man has been convicted of a crime on circumstantial evidence. If, later, you listen to grownups talking about the case, you may notice that they do not all agree that the man's guilt was proven. Let us suppose that John Jones is suspected of stealing a wallet containing a large sum of money. If someone actually saw him steal the wallet, this is direct evidence. If, however, he was merely seen on the night of the robbery loitering near the house from which the money was taken, and if later he seemed, from his extravagant spending, to have become rich overnight, and if the missing wallet was found in his room, these circumstances would seem to indicate that John Jones was the thief. This would be called circumstantial evidence. Further evidence of this sort could be brought forward, as, for instance, the fact that he knew where the owner kept his wallet. No single one of these facts could actually prove the man's guilt without the shadow of a doubt. But if, taken together, they indicate his guilt, beyond reasonable doubt, he is convicted.

Most evidence is circumstantial, for few criminals are seen engaged in the act of their crimes. Mistakes sometimes occur. However, if only direct evidence were allowed, as proof of guilt, most wrong-doers would escape scot-free. So the use of circumstantial evidence in court helps to protect the rights and property of law-abiding citizens.

THE NEXT WONDER QUESTIONS ARE ON PAGE 4276.

MORGIANA BEGINS HER FATEFUL DANCE

Morgiana had dressed herself like a dancer, girded herself with a silver girdle, and hung there a poniard with a hilt and guard of silver. When the dessert had been served she danced into the room and began a whirling dance of marvelous swiftness and grace. As she danced she held the poniard in her hand, pointing it first at one, and then at another of the diners, as though about to plunge the needle-sharp dagger into his heart.

Ali Baba and The Forty Thieves

From THE ARABIAN NIGHTS ENTERTAINMENT

THERE once lived in a town of Persia two brothers, one named Cassim, and the other Ali Baba. Cassim married a rich wife and became a wealthy merchant, but Ali Baba, who was gentle and honest and never a schemer as was his brother, married a woman as poor as himself and lived by cutting wood and bringing it upon three asses into town to sell.

One day when Ali Baba was in the forest, he saw at a distance a great cloud of dust which seemed to approach him. He watched it intently, and saw that it was a body of horsemen who he suspected might be robbers, for such men infested that forest. To save himself, he left his asses and climbed up a large tree, the branches of which were thick enough to conceal him and yet permit him to see all that passed.

The troop, which numbered forty, all well mounted and armed, came to the foot of the tree and there dismounted. Every man took off his saddlebag which appeared to be uncommonly heavy, and was probably, thought Ali Baba, filled with loot. One, who seemed to be captain, came under the tree in which was Ali Baba, and, making his way through the shrubs to a large rock, said these words: "Open, Sesame!"* Instantly a door opened in the rock, and all the troop entered, whereupon the door shut of itself.

The thieves stayed some time within the rock, and Ali Baba, fearful of being caught, remained in the tree. At last the door opened again. The captain came out first and stood to see them all pass by him. Then he said: "Shut, Sesame!" The door closed, and the troop, mounting their horses, went back the way they had come.

As soon as he was sure they were not returning, Ali Baba descended from the tree and went in among the shrubs at the foot of the great rock, and perceiving a door con-

*"Sesame" is a small grain.

After the robber captain had spoken the magic words that opened the treasure cave, he and his men entered, each one carrying heavy saddle-bags filled with loot. Ali Baba watched them from his hiding-place in the tree.


"Cassim, you think yourself rich, but Ali Baba is infinitely richer!"

cealed behind them, said: "Open, Sesame!" The door instantly flew wide open.

Ali Baba saw a spacious chamber which received light from an opening at the top, and in which were rich bales of silk, valuable carpeting, gold and silver in great heaps, and money in bags. These riches made him suppose that this cave had been occupied for ages by robber bands who had succeeded one another.

Ali Baba collected as much of the gold coin as he thought his three asses could carry, loaded the bags upon his beasts, and laid brushwood over them in such a manner that they could not be seen. Then he pronounced the words: "Shut, Sesame!" and the door closed of itself.

When Ali Baba got home, he drove his asses into the yard, shut the gates carefully, and calling to his wife to come quickly, he carried the bags into his house. There he emptied bag after bag of shining gold onto the kitchen floor, and his dazzled wife—a good but simple woman—could only clasp her hands and exclaim in joy and fright: "Husband, husband, where have you been, and who has intrusted you with all this wealth?"

Ali Baba told her the whole adventure from beginning to end, and warned her to keep it secret. Then his wife, quite beside herself, would count the gold, piece by piece.

"You would never have done," said Ali Baba. "And we must work swiftly now, lest our neighbors suspect. I will dig a hole and bury it. There is no time to be lost."

"You are in the right, husband," replied she. "But let us know as nigh as possible how much we have. I will borrow a small measure, and measure it while you dig the hole."

Away ran the wife to her sister-in-law, Cassim's wife, who lived just by, and asked her to lend a measure. The sister-in-law did so, but as she knew Ali Baba's poverty, she was curious to know what sort of grain his wife wanted to measure. Artfully she rubbed some suet at the bottom of the measure and brought it out saying: "Return it as soon as you can, dear sister, for I have need of it today."

Ali Baba's wife went home, and filled and emptied the grain-measure time after time, counting the number as she did so. Then, while Ali Baba was burying the gold, she carried the measure back to her sister-in-law, but without noticing that a piece of gold had stuck to the bottom. "Thank you, sister," she said, and could not refrain from giving her head a proud little toss. "In return, you must not hesitate to borrow from me anything you may need!"

As the wife of Ali Baba had never possessed anything that Cassim's wife could possibly need, the suspicion in the breast of the rich sister-in-law increased multifold. And when she came to examine the measure and found the piece of gold sticking to it, envy consumed her. "What!" cried she, "Has Ali Baba gold so plentiful as to measure it? Whence has he all this wealth?"

Cassim, her husband, was at his counting-house; when he came home his wife was waiting for him at the gate. "Cassim," said she, "you think yourself rich, but Ali Baba is infinitely richer than you. He does not count his money, but measures it!" Then she told him the strategem she had used to make the discovery, and showed him the piece of money, which was so old that they could not tell in what prince's reign it was coined.

Cassim, after he had married the rich widow, had never treated Ali Baba as a brother. Now he felt base envy. He could not sleep all that night, and went to his brother in the morning before sunrise. "Ali Baba," he said, "you have not treated me as a true brother. You have pretended to be miserably poor, and yet you measure gold. My wife found this at the bottom of the measure you borrowed yesterday."

Ali Baba knew then that his own wife's

folly had revealed what must, at all costs, be concealed. But what was done could not be undone. Therefore, he swore his brother to secrecy and told him all.

"I must know exactly where this treasure is!" Cassim exclaimed in great excitement. "Otherwise, I shall inform against you!"

Now Ali Baba was forced to tell that part he had sought to conceal, even to the words used to gain admission into the cave.

Cassim rose the next morning long before the sun, and set out for the forest with ten mules bearing great chests. When he reached the entrance to the cavern, he pronounced the words, "Open Sesame!" The door immediately opened, and when he was in, closed upon him. Cassim trembled with greed and delight as he surveyed the riches which were even greater than he had expected. He collected as many bags of gold as his ten mules could carry, but his thoughts were so full of the great riches he should possess that he could not think of the words to make the door open and let him out! Instead of "Open, Sesame!" all he could think of was "Open, Barley!" But the great door remained fast shut. At first unalarmed, but then with increasing fright, he named several sorts of grain, but still the door would not open.

Cassim had never expected such an incident, and the more frightened he became, the more his memory failed him until he had as much forgotten the magic words as if he had never heard them. He threw down the bags he had loaded himself with and walked distractedly up and down the cave, no longer even seeing the riches that were round him.

About noon the robbers returned to the cave. At some distance they saw Cassim's mules straggling about the rock with great chests on their backs. Alarmed at this, they galloped full speed to the cave, and with their naked sabers in hand, rushed to the door.

Cassim, who heard the noise of the horses' feet, resolved to make one supreme effort for his life. He rushed to the door, and no sooner was it opened than he leaped out upon the leader, but the band of robbers, pushing in, struck him down with their scimitars.

Cassim trembled with greed and delight as he surveyed the riches of the cave, which were even greater than he had expected.

The first care of the robbers after this was to examine the cave. They found all the bags which Cassim had brought to the door, but they did not miss what Ali Baba had taken away before. They could not imagine how Cassim had learned the secret words by which alone he could enter, but to terrify any accomplice who should attempt the same thing, they hung Cassim's body within the door of the cave.

In the meantime, Cassim's wife became uneasy when night came and her husband had not returned. She ran to Ali Baba, and said: "Cassim went to the forest and has not returned. I am afraid some misfortune has happened."

Then Ali Baba knew that Cassim must have gone to the cave, and he told the wife she need not frighten herself for that certainly Cassim would not come into the town till the night should be far advanced. Cassim's wife

Ali Baba took his brother's body from the cave at night, loading it upon an ass and covering it with brushwood.

went home again and waited, her fear redoubling, and her grief all the greater because she was forced to keep it to herself. She repented of her foolish curiosity and cursed her desire to pry into the affairs of her brother and sister-in-law. She spent all night in weeping, and as soon as it was day went to Ali Baba begging him to go seek her husband.

Ali Baba went to the forest with his three asses, as though he were going to cut wood as usual. When he came up to the rock he found some blood spilled near the door, and when he had pronounced the words: "Open, Sesame!" and entered the cavern, he was struck with horror at the sight of his brother's body. He loaded Cassim over one of his beasts, and put bags of gold across the other two, covering everything over well with brushwood. Then, stopping some time at the end of the forest that he might not go into the town before night, he came at last to his home. There he left the unloading of the gold to his wife, and he took himself to Cassim's home, with the one ass that bore his brother's body.

In answer to his knock, the door was opened by Morgiana, a clever and beautiful young slave-girl. Because this girl knew all that went on within the household, Ali Baba told her the whole story and delivered over to her the body of her master, counseling her to observe great secrecy and to tell her mistress that Cassim must be buried as if he had died a natural death. Morgiana swore to do this, and Ali Baba returned to his own home.

The next morning, Morgiana went early to the druggist and asked for a sort of lozenge which was given to people with the most dangerous disorders. "My good master, Cassim, is ill," she said. In the evening Morgiana went to the same druggist and with tears in her eyes asked for an essence given to sick people only when at the last extremity. "Alas," said she, "I am afraid this will have no better effect than the lozenges! Heaven forbid that I lose my good master, but I fear it will be so!"

Nobody was surprised in the evening to hear the lamentable shrieks of Cassim's wife and of Morgiana who ran to tell the neighbors that her master was dead. No hands but those of Morgiana and Ali Baba touched the body, lest the scimitar wounds be discovered, but all was done with great cleverness, and at a great funeral the women of the neighborhood came, according to custom, and joined their lamentations with those of Cassim's wife, filling the quarter far and near with sounds of sorrow.

Three days after the funeral, Ali Baba removed his few goods openly to his sister-in-law's house, but the money he had taken from the robbers he conveyed thither by night. As for Cassim's warehouse, he intrusted it to the management of his eldest son.

At this time, the forty robbers again visited their retreat in the forest, and great was their surprise to find Cassim's body taken away, with several bags of their gold.

"We are certainly discovered!" exclaimed the captain. "The man whom we killed had an accomplice, and for our own lives' sake we must find him. What say you, comrades?"

All of the robbers agreed, and one of them, the boldest of the lot, said: "Let me go into town disguised as a traveler, to try if I can hear any talk of the man whom we have killed."

After this robber had received great commendations from the captain and his comrades, he disguised himself and went into the town just at daybreak. He walked up and down till he came to the stall of the cobbler,

Baba Mustapha, which was always open before any of the other shops.

Baba Mustapha was seated with an awl in his hand, just going to work. The robber saluted him, saying: "Old man, you start your work early. But I doubt not that work agrees with you, for you appear to be in rare health. Tell me—for I am a stranger here—is the climate of this town so healthy that all live to be as old as you?"

"That they do not," replied Baba Mustapha. "Many die suddenly, in youth or middle years."

"Now that grieves me to hear that," artfully said the robber. "Tell me, old one, who has died but lately?"

"There was this one and that one," answered Baba Mustapha, counting them on his fingers, "and there was Cassim the merchant, who was ill but a day."

"This Cassim," said the robber, "was he a man of middle years, stout, and with a cast in one eye?"

"That was he," said the old man. "And if you knew him, you must also know his brother, Ali Baba, who once was poor and cut wood in the forest, but who moves today into Cassim's house, possessing Cassim's wealth!"

"It rejoices me to hear of Ali Baba's good fortune," exclaimed the robber, "for I knew him well. I would greet him." He put a piece of gold into Baba Mustapha's hand, and said: "Show me his house."

At the house of Cassim into which Ali Baba would that day move, the robber dismissed the old man, and he marked the door with a piece of chalk. Then he returned to the forest.

A little after the robber left, Morgiana went out upon some errand, and upon her return, she noticed the mark the robber had made.

"What can be the meaning of this mark?" said she to herself. "Somebody intends my new master no good!" She fetched a piece of chalk and marked three doors on each side in the same manner.

In the meantime, the robber rejoined his troop and recounted his experience with the utmost satisfaction. His captain commended his cleverness and said: "Comrades, we have no time to lose. But we must not excite suspicion, so let only one or two go into the town together, and join at our rendezvous, which shall be the great square. In the meantime, our comrade who brought us the good news and I will go and find out the house."

They were soon armed and ready, and left in parties of two, the captain and he who had visited the town in the morning coming in the last. The spy led the captain to the street where he had marked Ali Baba's residence, and when they came to the first of the houses which Morgiana had marked, he pointed it out. But the captain observed that the next door was chalked in the same manner, as were five other houses. Then the spy assured the captain, with an oath, that he had marked but one, and could not tell who had chalked the rest.

The captain, losing all confidence in his

"Alas, my good master, Cassim, is ill," Morgiana told the druggist.

A voice from within the jar whispered softly "Is it time?"

Now the captain decided that the heads of his band were not so good as their hands, and therefore resolved to take upon himself the important commission.

Accordingly, he went and addressed himself to Baba Mustapha who did him the same service he had done to the other robbers. He did not set a mark on the house, but examined it carefully. Well satisfied that he would know it again, he went to his troop in the forest and said: "Comrades, now nothing can prevent our full revenge." He then told them to go into the smaller villages that lay about the forest and buy nineteen mules with thirty-eight large leather jars, one full of oil and the others empty.

When the robbers had purchased the mules and jars, the captain had them widen the mouths of the jars, and he put one of his men into each, with their weapons, and he rubbed the jars on the outside with oil from the full vessel. Then he set off for town with the nineteen mules loaded with thirty-seven robbers in jars, and the jar of oil. He led them through the streets till he came to Ali Baba's. There he saw Ali Baba himself sitting outside, taking a little fresh air after supper. He stopped his mules and said: "I have brought some oil a great way to sell at tomorrow's market, and it is now so late that I do not know where to lodge. Do me the favor to let me pass the night with you."

Ali Baba did not recognize the captain of the robbers in the disguise of oil merchant. He told him he was welcome, and opened his gates for the mules to go into the yard.

Now, when supper was over, Morgiana began to prepare a broth for her master to drink the next morning when he returned from his bath, but while she was preparing it, the lamp went out, and there was no more oil in the house. What to do she did not know, for the broth must be made. Then a male slave, Abdalla, seeing her unease, said: "Do not fret, but go into the yard and take some oil out of one of the jars."

Morgiana took the oil-pot and went into the yard. When she came nigh the first jar,

bewildered henchman, went to the place of rendezvous and led his troop back to the forest. There they set upon the robber who had thought himself so clever and beat him almost to death. Another of the gang offered to go to the town, and the next morning he set out early, and he, too, found Baba Mustapha and besought him to lead him to the house of Ali Baba, brother to Cassim who had died. Being shown the house, he marked it in a place more remote from sight, with red chalk.

Not long after, Morgiana, whose pretty eyes saw everything, went out, and coming back she looked the house-front over and found the red chalk mark. As before, she marked the neighbors' houses in the same place and manner.

The robber, on his return to his company, boasted on the precaution he had taken, and the captain thought it must succeed. They went into the town late that night, but when the spy and his captain came to the street, they found, as before, that seven houses, not one, were marked.

the robber within said softly: "Is it time?"

Controlling herself, and without showing the least emotion, Morgiana, deepening her voice, replied: "Not yet, but presently." She went quickly in this manner to all the jars, giving the same answer till she came to the jar of oil. Making haste to fill her oil-pot, she returned to her kitchen where, as soon as she had lighted her lamp, she took a great kettle, went again to the oil-jar, filled the kettle, set it on a large wood fire; and as soon as it boiled she went and poured enough boiling oil into every jar to destroy the robber within.

When this was done, she returned to the kitchen, put out the lamp and sat herself by the window that opened into the yard. She had not waited long before the captain of the robbers opened his window, and hearing no one stirring in the house, gave the signal he had agreed upon with his men; he threw little stones at the jars and heard them strike. But when his companions did not stir he grew uneasy; he threw stones a second time, and a third, and could not understand why none of them answered his signal. Much alarmed he went softly down into the yard, and smelled the hot oil which sent forth a steam out of each jar. Examining all the jars, one after the other, he found that all his robber band were dead! Immediately he forced the lock of a door that led from the yard to the garden, and climbing over the walls made his escape.

Ali Baba rose before day and went to the baths, entirely ignorant of the important event which had happened at home. When he returned, he was surprised to see the oil-jars, and called Morgiana.

"Has not the merchant gone yet with the mules?" he asked.

Then Morgiana led him to the oil-jars and showed him what was within. "Merchant!" she said. "He was no more merchant than I. He was the captain of the robber band, and here are his men, a danger to you no longer." Then she told him, for the first time, of the two chalk marks she had found and of how she had outwitted the robbers both times.

On hearing of these brave deeds, Ali Baba said: "I owe my life to you. From this moment you are free. But I intend greater recompense than this and one which, I think, will please you, my dear Morgiana. I shall tell you of it later. Now you must summon Abdalla to help me."

Ali Baba's garden was very long, and shaded at the farther end by a great number of large trees. Near these he and the slave, Abdalla, dug a trench to hold the bodies of the robbers. When they were buried, Ali Baba hid the jars and weapons and sent the mules to be sold in the market.

While Ali Baba did these things, the robber captain returned to the forest, but the loneliness of the gloomy cavern became frightful to him. He determined to avenge the fate of his companions, and to accomplish the death of Ali Baba. For this purpose, he returned to the town and took a lodging in a khan, or inn, disguising himself as a merchant in silks. Gradually he brought rich silks and fine linen to his lodging from the cavern, and he took a warehouse opposite to Cassim's, which the son of Ali Baba had occupied since the death of his uncle. And the robber captain took the name of Cogia Houssain.

As soon as Cogia Houssain became acquainted with the son of Ali Baba, he made him some small presents, and often asked him to dine and sup with him, when he treated the young man very handsomely. The youth told his father of this new friend, and Ali Baba said: "Son, tomorrow being Friday, the shops of such merchants as Cogia Houssain and yourself will be shut. Bring you this new friend to supper."

The next day, Ali Baba's son brought Cogia Houssain to his father's house, and Ali Baba received the supposed silk merchant with a smiling countenance. "It is a pleasure

Morgiana was married to Ali Baba's son, who had long loved her.

to entertain my son's new friend," said he.

"Sir," replied the pretended Cogia Houssain, "I am persuaded of your good will, but the truth is, I can eat no food with salt in it; therefore, judge how I should feel at your table."

"Do not distress yourself," said Ali Baba, "I promise you no salt shall be put in the food we eat tonight."

Thereupon Ali Baba went into the kitchen, and requested Morgiana to put no salt in the meat that was to be dressed that night, and to make quickly two ragouts besides what he had ordered, but to be sure to put no salt in them.

Morgiana was surprised. Not so trusting as her master, she thought of the law of the Mohammedans which says that the worst fate in after-life is reserved for that man who kills one with whom he has eaten salt. To Abdalla she said: "I must see this man who eats no salt with his meat. Can it be an enemy who would assassinate our master?"

Therefore, when supper was ready, she helped Abdalla carry up the dishes, and looking at Cogia Houssain, knew him at first sight, notwithstanding his disguise, and she perceived that he had a dagger under his garment.

Now Morgiana determined to execute one of the boldest acts she had ever meditated. While Abdalla served the dessert of fruit, and put it before Ali Baba with the wine and glasses, Morgiana dressed herself like a dancer, girded her waist with a silver girdle and hung there a poniard with a hilt and guard of the same metal. Then she said to Abdalla: "Take your tabor, and let us go and divert our master and his son's friend, as we sometimes do when he is alone."

Abdalla took his tabor and played all the way into the hall before Morgiana, who, when she came to the door, made a low obesiance, then danced into the room and began a whirling performance that would have created admiration in any company. The son of Ali Baba, who was already in love with Morgiana, exclaimed aloud, his eyes gleaming, and even Cogia Houssain, though annoyed at this diversion which he feared might lose him the opportunity he thought he had found, could not but applaud the grace and beauty of the girl.

Morgiana began another dance. She drew the poniard, and holding it in her hand, outdid herself by many different figures and light movements. Sometimes she presented the poniard to the breast of Ali Baba, then his son, then Abdalla, and herself. At last she snatched the tabor from Abdalla with her left hand and, holding the dagger in her right, presented the hollow side of the tabor to one after another, laughing the while, mimicking the manner of those who get a livelihood by dancing and solicit the liberality of the spectators.

Encouraging the play, the son of Ali Baba put a piece of gold into the tabor, as did also Ali Baba; and Cogia Houssain, seeing she was coming to him, pulled his purse out of his bosom. As he put his hand into it, Morgiana plunged the dagger into his heart.

Ali Baba and his son cried aloud at this terrible act, but Morgiana opened the pretended Cogia Houssain's garment and showed the dagger.

"Look well at him," she cried. "He is the captain of the gang of forty robbers! Did you not know it when he refused to eat salt with you?"

"Oh, Morgiana!" said Ali Baba when he had examined well the body that lay still upon the floor, "How you have preserved me and my family! I promised you that my gratitude should not stop at giving you your liberty. I now make you my daughter-in-law."

Addressing himself to his son, he said: "I believe you, son, to be so dutiful that you will not refuse Morgiana for your wife. But should you be hesitant, consider that by marrying Morgiana you marry the preserver of my family and your own."

The son consented with haste, only smiling privately that his father should ask him to do in the name of duty what he had long wished to do in the name of love. They buried the captain of the robbers with his comrades, and a few days afterwards Ali Baba celebrated the nuptials of his son and Morgiana with great solemnity. Ali Baba did not visit the robbers' cave for a year, as he thought the other two robbers might be alive. At the year's end, when he found they had made no attempt to disturb him, he visited the cavern once more with his son, teaching him the words: "Open, Sesame!" He found nobody had been there since the captain had fetched the goods for his shop. From this time on, all the treasure was at his disposal, and he and his son used their good fortune with moderation, living in honor.

THE NEXT STORIES ARE ON PAGE 4301.

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VOLUME XII

The Book of Knowledge

The Children's Encyclopedia

THAT LEADS TO LOVE OF LEARNING

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The

BOOK OF KNOWLEDGE

The Children's Encyclopedia

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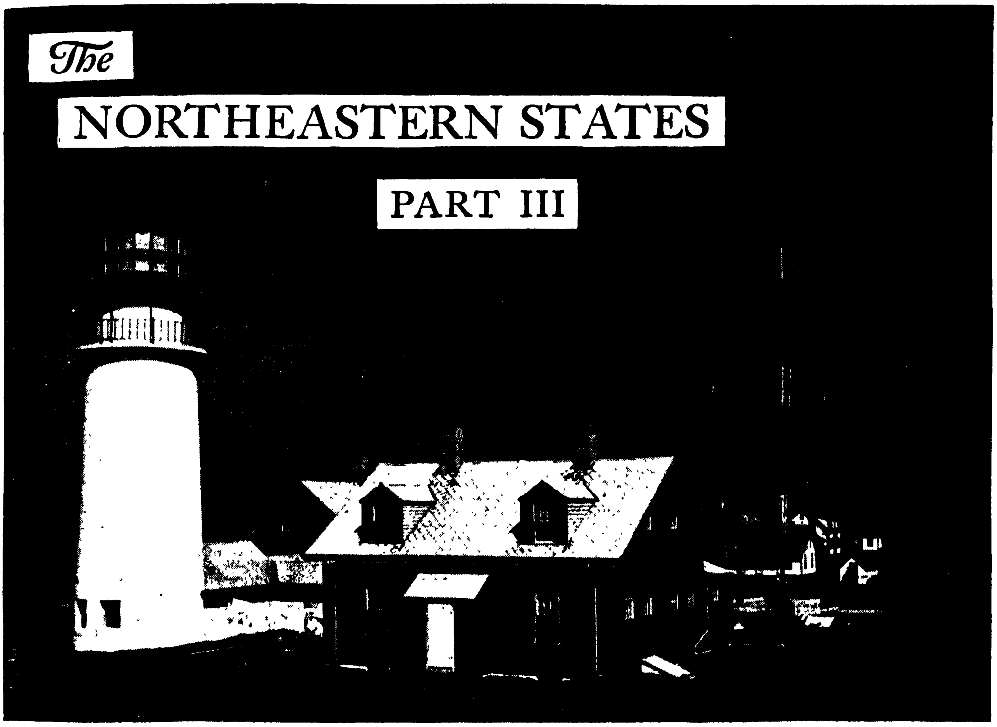
Contents of Volume XII

This is a guide to the principal contents of this volume. It is not possible to give all of the questions in the Department of Wonder, but the pages are given where such sections begin. The big Index in Volume 20 is a guide to your whole set. There you will find every subject that is in THE BOOK OF KNOWLEDGE.

Contents of Volume XII—continued

The NORTHEASTERN STATES

PART III



Philip Gendreau, N. Y.

The Highland Lighthouse on Cape Cod, Massachusetts.

As we have seen, the sea served the earliest settlers twice, and twice they left the sea behind. The first time it served them was when they sailed across it to make their homes here; and the second was when they turned to the sea for trade and privateering. They left it for manufacturing, but as the years went by people have realized the advantages of the sea, and the Northeast has turned back to it again. These advantages are mainly three in number. The sea is a source of food and raw material, it is a medium of travel and it is a source of pleasure and comfort.

As a source of food and raw materials the sea is of increasing value. If the land can not in the future supply us with all of our food, as some say, then the large sources of sea food which are as yet undeveloped must be called upon as an additional supply. To-day there is still some difficulty in marketing fish because of the uncertainty of the markets. Gloucester, Massachusetts, is perhaps the best-known fishing town and has developed extensive industries in preparing fish for distant markets. Boston, however, is a larger fishing centre than Gloucester, and much of the fresh fish distributed throughout the Northeast comes from the Boston markets. Cod is the common fish, but mackerel, herring, swordfish and halibut are widely distributed. In the shallower waters along the shore, lobsters, clams and oysters abound. Long Island Sound, Cape Cod, Delaware Bay and Chesapeake Bay oysters are well known.

In the second place, the sea as a medium of travel is now made use of as never before, and consequently the Atlantic seaboard has a position of supreme importance. Ships leave its ports for all parts of the world.

Four ports — New York, Philadelphia, Boston and Baltimore—handle nearly half the tonnage of the foreign commerce of the United States, while through New York alone passes almost half of the enormous annual value of the foreign trade of the United States. New York has the advantage of being the natural gateway to the West. The moun-

A. F. Sozio from Gendreau
Children in costume of several "old countries" round a May Pole in New York.

tain ranges which parallel the Atlantic coast are cut across in New York State by the broad valley of the Mohawk, which extends practically from Buffalo to Albany. The valley is densely populated, containing such cities as Rochester, Syracuse, Utica and Schenectady, as well as many smaller centres. Through this valley run the main railroad lines to the interior and the West, and the New York State Barge Canal (Erie Canal) connecting Lake Erie, at Buffalo, with the Hudson River. At Albany the narrow valley of the Hudson River continues the thoroughfare to New York City. New York Harbor is the terminus of about one hundred steamship lines, and it is said that in normal times an ocean liner passes in or out of the harbor on an average of every ten minutes throughout the day. The goods brought in are distributed by means of railroad lines and coastwise steamers.

Boston has the advantage of being nearer Europe than New York; but from the standpoint of the larger part of this country, the port is somewhat isolated. From Albany the railroad must climb over a thousand feet to

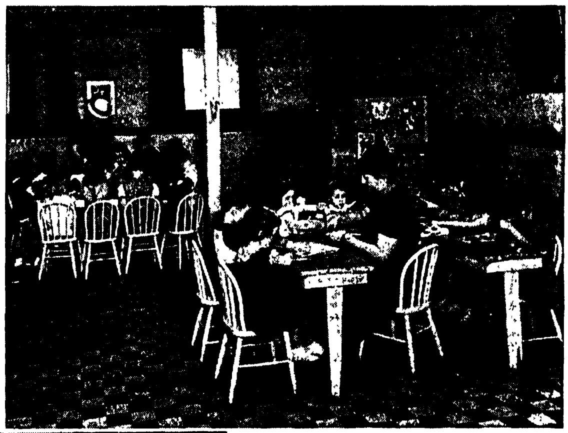
Frederic Lewis
Testing the strength of oxen at a county fair in Vermont. At state and county fairs everyone has a good time.

surmount the Berkshire Hills, while it is down grade to New York.

Philadelphia and Baltimore lie farther inland, the former 110 miles from the sea, by way of Delaware Bay, and the latter about 200 miles. They are in a densely settled area and are not so shut in as Boston. The Coastal Plain and the Piedmont Belt, which parallel the Atlantic coast, both produce and consume great quantities of goods. As far as the West is concerned, they have little advantage over Boston, since the Pennsylvania Railroad from Philadelphia and the Baltimore & Ohio Railroad from Baltimore must ascend well over two thousand feet in order to cross the Appalachian Highlands and penetrate the interior. In its contact with the West, New York stands alone, superior to all other ports.

Ports to-day are very complicated affairs. A statement is made that "a great ocean freighter was recently loaded in New York Harbor with a cargo destined for a distant South American port, when, just before the sailing hour, it was found advisable to withdraw the steamer. It was, however, discovered that the cost of unloading the cargo and transferring it a distance of sixty feet on the dock would equal the entire expense of carrying it five thousand miles or more to South America." The problem of loading and unloading is expensive, as you see. Wages of a large number of people must be paid while the vessel is in port, and any delay means a heavy loss. Consequently the ports must have intricate machines, electric trucks and handtrucks, great power derricks and every facility for speeding up the work. All these are found at modern docks to-day.

Remember that a vessel may be 1,000 feet long over all and that six of these mean a mile of docking space; and also that there might be two hundred ocean vessels in the harbor of New York at one time, since so many steamship lines have that port for a terminus. About thirty-five miles of dockage space would then be required. Add to this the large number of ferry boats that ply between Manhattan Island and Brooklyn, Jersey City and the adjacent shores, the Hudson River steamers and the coastwise steamers, and it can be seen that dockage for all these boats is a serious problem. This is partly solved by having long piers and docking the vessels at right angles to the shore. Even with this device the larger Atlantic ports are finding docking problems very burdensome.



Pictures, Ewing Galloway, N. Y.

Little tots learning to work and play together in the friendly atmosphere of a kindergarten in the basement of a church.

Hobby room in a boys' club, where members try out various crafts. The northeastern states have gone far in community welfare.

The third value of the sea is the use of it as a pleasure-ground. The Atlantic shore is almost a continuous summer colony from Eastport, Maine, southward. The best-known of the resorts are Newport, Rhode Island, and Atlantic City, New Jersey. Newport is the summer home of very wealthy people. The cottages can hardly be considered cottages in the ordinary sense, since they range in cost from $200,000 to $2,000,000. Atlantic City is open the year round and caters to all classes of people. It is, unlike Newport,

predominantly a resort of hotels and boarding houses. Thousands of people visit here during the year, and the famous boardwalk at the height of the season, on Easter Sunday, is possibly more crowded than any other street in the country. In addition, famous but less well-known resorts are found at Bar Harbor and Old Orchard Beach, Maine, on Cape Cod, Massachusetts, at Narragansett Pier and Watch Hill, Rhode Island, at Rockaway Beach and Coney Island, New York, and at Asbury Park and Ocean Grove, New Jersey.

The advantage of the shore in summer arises from the lower average temperature which prevails, first, because the larger amount of water vapor in the air does not allow the sun's rays to penetrate so easily; second, because the evaporation tends to lower the temperature; and, third, because the water surface will not get so warm as the land surface when the sun is shining. Thus a breeze from the water will in summer be some degrees lower than a breeze from the land. The main attraction, however, is the bathing, and the bathing-beaches are crowded during the warm days of summer. Along the Maine coast rocky headlands and islands are common. These are remnants of the land left by the eroding glacier which wore away the softer areas to form great bays and channels. Few beaches are found along the Maine coast, and because the water is deep in the fiord-like channels and the tides turn it over constantly, the temperature of the water is much colder than where shallower water and sandy beaches prevail. Southward from Maine, beaches increase in number, until from New Jersey southward there is almost a continuous beach facing the Atlantic Ocean.

Philip Gendreau, N. Y.

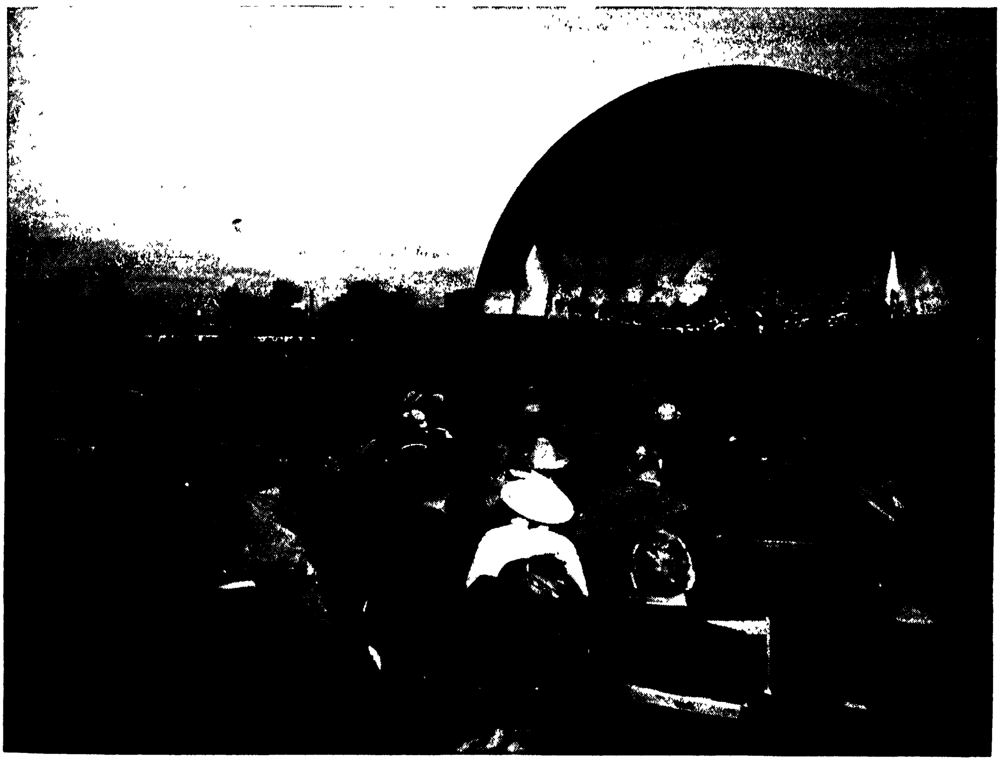
An adult education class in citizenship, in Brooklyn. These foreign-born women are on their way to becoming Americans. A large proportion of the immigrants to the United States have entered the country through the Northeast.

In addition to the great playgrounds found along the coast, the mountains offer a different kind of resort for those who prefer them. Here drier conditions exist, the altitude and the open vegetation-covered spaces

tend to give much lower temperatures than the cities experience, and the variety and grandeur of the scenery are attractive.

Most famous of the mountain resorts are the Adirondack Mountains. These have a combination of mountain and lakes, with much wooded area, which give a dry, cool and invigorating atmosphere. It has been known as a health resort, hunting-ground and pleasure area for years. To the south of the Adirondacks are the Catskill Mountains (really a plateau), which teem in summer with the New York City lovers of open spaces; farther south, in Pennsylvania, are the Appalachian Highlands, culminating in the famous resorts of the Pocono Mountains. To the north the Berkshire Hills in western Massachusetts, the Green Mountains of Vermont and the White Mountains of New Hampshire offer excellent summer sport. Mount Washington, 6,279 feet, is the highest peak in the Northeast.

In addition, the area is a lake country, and along the shores of large and small lakes, hotels, summer settlements and camps offer fresh-water bathing, fishing and sports to the advantages of the inland spaces. Most beautiful of them all is Lake George, in New York near the Vermont border; and the largest of them (not counting the Great Lakes) lies to the north—Lake Champlain.

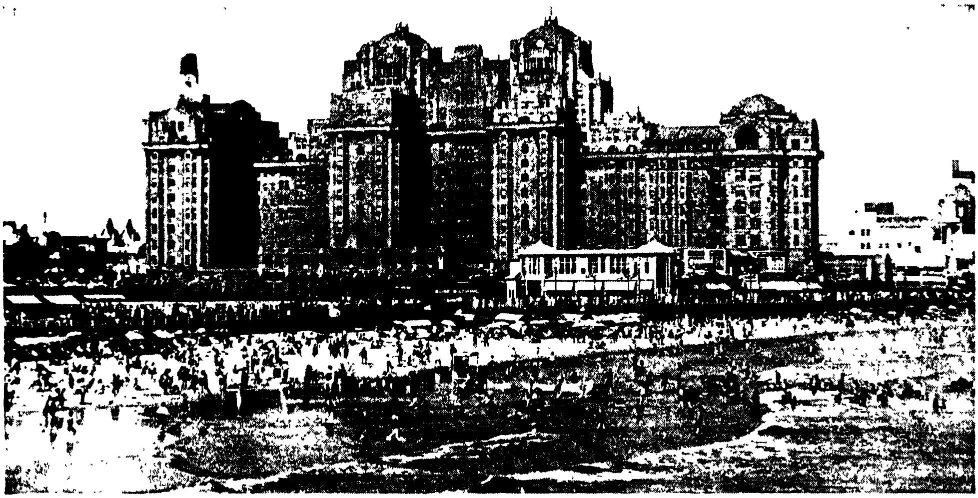


Ewing Galloway, N. Y.

A free symphony concert in the open air, on the bank of Charles River, at Boston. In many American cities outdoor summer concerts are given so that people may hear good music free, or inexpensively.

Recreation as a business stands second to manufacturing in New England. The annual intake in New England from recreational sources is estimated by the New England Council, economic development and research body for the six states, at $500,000,000, roughly divided as follows: Maine, $100,000,000; New Hampshire, $87,500,000; Vermont, $33,500,000; Massachusetts, $172,500,000; Rhode Island, $56,500,000; Connecticut, $45,000,000.

It is convenient when studying a country to divide it into regions of like surface features rather than to study the area on the basis of political units such as the state or



New Jersey Council, photo by Central Studios

A section of the beach and one of the great hotels at Atlantic City, New Jersey. Much of the eastern coastline, from Maine to Florida, belongs to holiday land; and millions of people find rest and fun by the oceanside.

nation. The Northeastern section has a number of such physical regions. The characteristics of these have been mentioned at various places in the text: (1) The Coastal Plain extends southward from New York City, between the shore and the edge of the plateau. (2) The Piedmont Belt lies the length of the Northeast from Maine southward. In New England the eastern boundary is the shore, father south it is the fall-line, and the western boundary the mountains. (3) The Appalachian ridges and valleys (Great Appalachian Valley) are a belt running parallel to the former and lying adjacent to it on the west. (4) The Appalachian plateaus include the Allegheny and Catskill plateau section. (5) The Mohawk Valley. (6) The Adirondacks in northern New York.

The climate of the section shows great extremes. The winters are cold and the summers warm. However, it is not the coldest or the warmest belt in the United States. The summer heat is moderated by altitudes in the interior and by the nearness to the sea; and most towns and cities have near at hand some refuge from the heat of closely built places, either shore resort or lake. The sea also moderates the winter cold, but its influence lessens rapidly as one goes inland.

Snow covers all the area during the winter. In the north the snow stays on the ground continuously, sometimes for five months, but along the coast and in the south the "open" winter frequently prevails. Snow falls early in the north—occasionally roads in New England hills and mountains are deep in snow on October 10—and remains late. Frequently in the spring when the snow melts, heavy floods do much damage.

Temperatures are frequently and best recorded by the length of the growing season, that is the number of days between the last killing frost in spring and the first in the fall. In Maryland and Delaware this is about 200 days; in New Jersey and southern New England, 190 days; central Pennsylvania, 140 days; northern Maine, 120 days; while around Lake Ontario it rises to 170 days. Thus the southern part of the area has nearly a three months longer growing season than the extreme northern. This is shown in the Boston market by the vegetables and fruits coming from Maryland, Delaware and New Jersey before the home crop is ready.

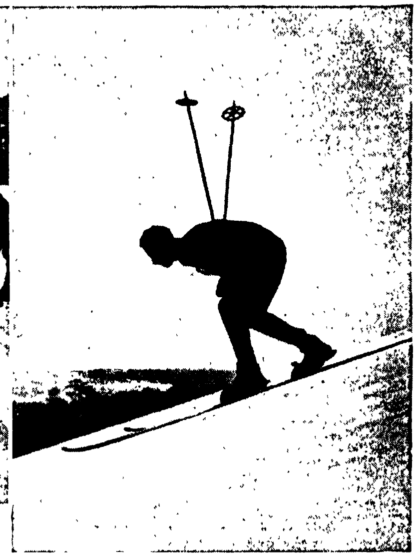
The rainfall varies, but in general it may be said to average about 40 inches per year, spread almost evenly through the months.

Many regions in the northeastern states are noted for their cool summer breezes and their shore and beach playgrounds and recreation spots. Some of these areas have now become quite as famous for their winter sports. Many hotels in the mountains are open during the winter. Special excursion trains and buses, as well as private cars, pour their thousands of sports fans into the snowy regions. Snow-shoeing, skiing, skating and tobogganing are favorite sports.

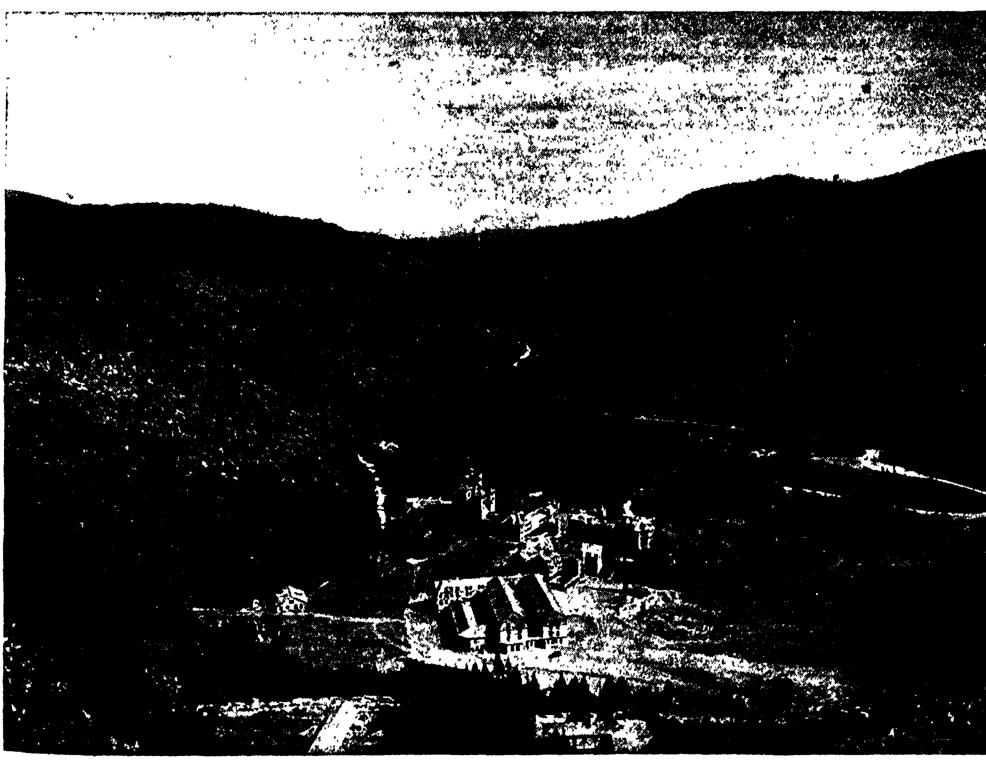
Now, having spoken of the agriculture,

IN HOLIDAY LAND, ALL YEAR ROUND

N. Y. State Division of Commerce
The Adirondack Mountains, in New York State, attract visitors all the year round. There are healthful sports both summer and winter. Here is a dog-team pulling a sled over the ice at Lake Placid.



Pennsylvania Department of Commerce
Skiing on a hill in Pennsylvania.



New England Council
Hotels at Dixville Notch, a gap in the White Mountains of New Hampshire. Spruce, fir, white pine mantle the hills.

the forestry, the mining, the manufacturing, the commerce and the climate of the section, what can we say of the people?

The first settlers of New England were chiefly English. New York, though settled first by the Dutch, soon received settlers from nearly every country of Europe, and at the time of the Revolution many languages were spoken in the colony; New Jersey and Delaware were also claimed by the Dutch, though Swedish settlements had been made on the Delaware. All these soon came under English rule. The founders of Pennsylvania were liberal from the first, and besides Englishmen thousands of Protestant Irish, German and Swiss came to the colony. Maryland, as you know, was founded as a refuge where persecuted Catholics might live undisturbed. The settlers were chiefly English, though here, as in all the colonies, there were some Catholic Irish and some Scotch.

The Dutch language soon became uncommon, and the same is true of the Swedish, but down to the present day good German may be heard in many Pennsylvania communities. It happens, however, that a mixture of German and English called Pennsylvania Dutch is more common than German in those counties where the Germans chiefly settled.

We have already told you of the way in which the New Englander moved westward. The inhabitants of the other states also moved, but Pennsylvania and New York were larger and the soil was richer. Many therefore simply moved westward within the states, up to the Revolution. Later these states furnished many settlers to the Mississippi Valley.

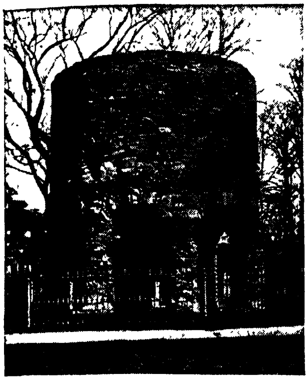
In spite of the hardships of pioneer life many of the settlers in all of the colonies prospered. Fine houses were built in the cities and towns. A few of the houses of the seventeenth century are still standing, and many which date back to the eighteenth. Some are excellent in design as well as in workmanship.

Philip Gendreau, N. Y.

Miners waiting to go down the shaft for their work in one of Pennsylvania's anthracite (hard coal) mines.

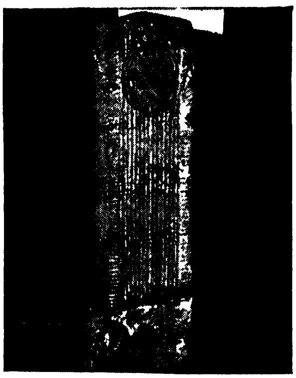
Some of the most beautiful houses are in the coast towns of New England which were once important ports. For example, Portsmouth, New Hampshire, has several imposing mansions. In Salem, Massachusetts, the wealthy merchants and shipowners built houses to fit their circumstances. Much of the elaborate carving was done by skilled ship carpenters. In rural towns there are also some fine old houses, and we shall show

MEMORIALS OF DAYS GONE BY



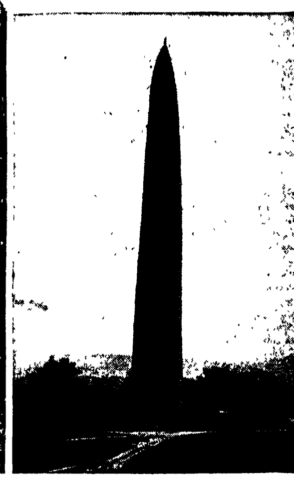
Ruins of an old mill, probably built by the great-grandfather of Benedict Arnold, the traitor.

The Wayside Inn at South Sudbury, Massachusetts, made famous by Longfellow. It was purchased by Henry Ford.

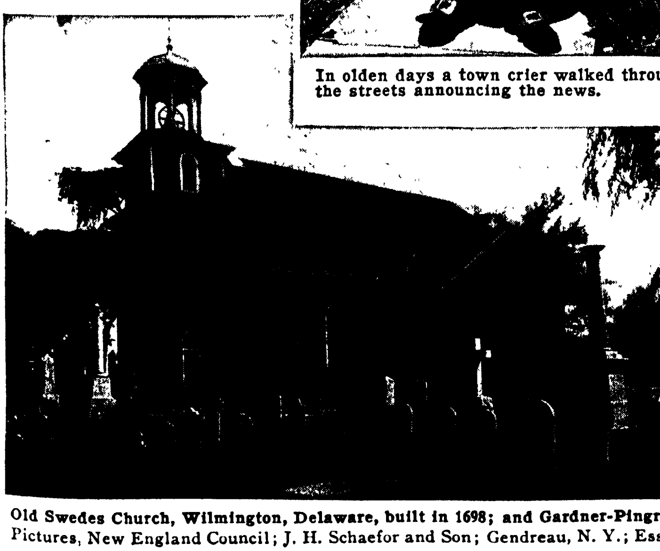


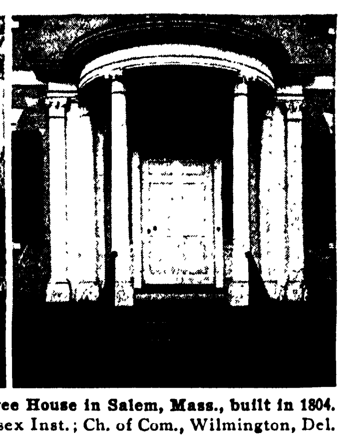
A Mason Dixon Line marker with coat-of-arms of Lord Baltimore.

In olden days a town crier walked through the streets announcing the news.



Monument that commemorates the Battle of Bennington, Vermont.

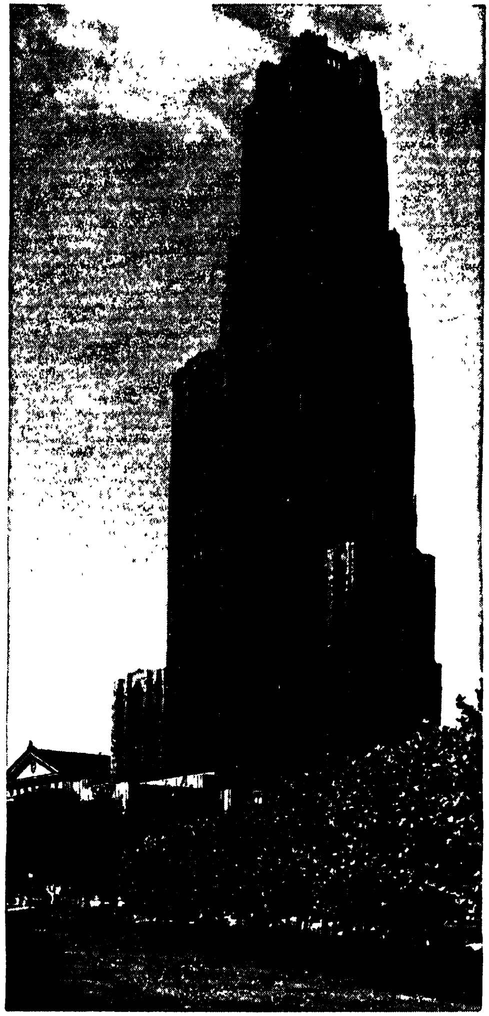




Old Swedes Church, Wilmington, Delaware, built in 1698; and Gardner-Pingree House in Salem, Mass., built in 1804.
Pictures, New England Council; J. H. Schaefor and Son; Gendreau, N. Y.; Essex Inst.; Ch. of Com., Wilmington, Del.

you some old Southern houses in other articles.

For fifty years after the Revolution few foreigners came to the United States, but with the development of manufactures immigrants came in great numbers from the British Isles, Germany and other countries of northern Europe. Toward the end of the nineteenth century the source of immigration shifted to Canada and to the countries of central and southern Europe. In 1940 there were nearly 700,000 persons of Irish birth in the section, and nearly 650,000 of German birth. These figures are surpassed by the ones that follow. There were nearly 775,000 of Polish birth, nearly 800,000 of Russian birth, and over 1,300,000 of Italian birth. There were over a half-million persons of Canadian birth in New England alone, almost equally divided between French-speaking and English-speaking. In fact, a little more than half of all the foreign-born in the United States live in the eleven states of the Northeast.



Philip Gendreau, N. Y.

The University of Pittsburgh's skyscraper college, forty-two stories high. More than 10,000 students attend this university, which was founded in 1787.

New York has the largest percentage of foreign-born—25.4; followed by Massachusetts, with 24.8; Connecticut, 23.8; Rhode Island, 21.3; and New Jersey, 20.9; New Hampshire follows with 17.8; Pennsylvania has 12.8; Delaware and Maryland have 7.1 and 5.8 respectively. The percentage of foreign-born in the United States as a whole is 11.6. If we add to the foreign-born those of foreign parentage, the proportion is much larger.

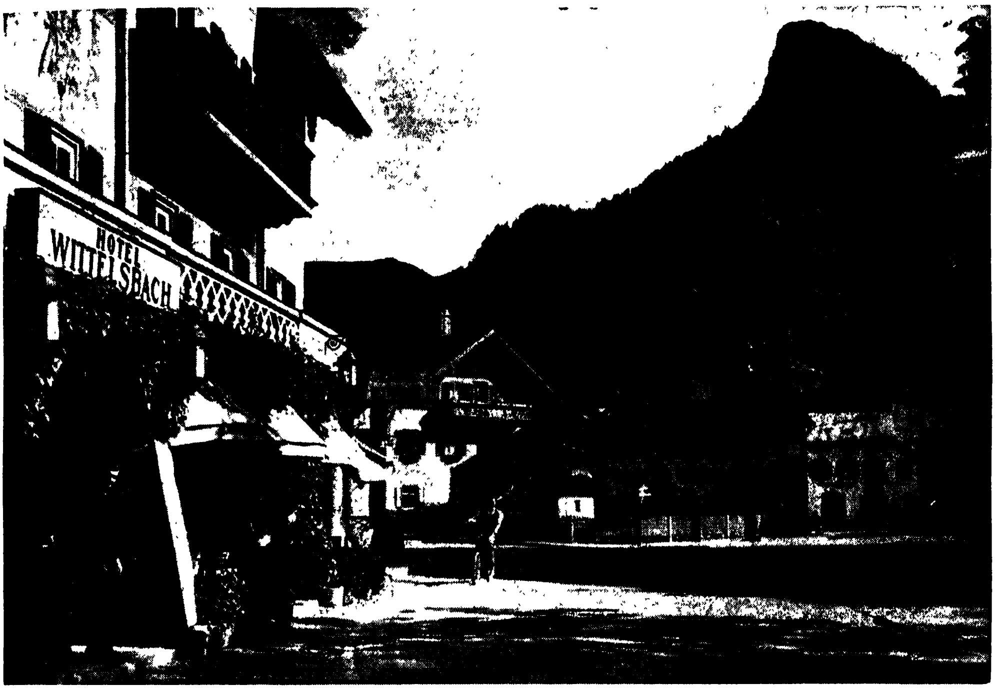
In some of the states most given to manufacturing the proportion of native whites of native parentage is very low. In Rhode Island it is only 30.7; in Massachusetts, 33.6; in Connecticut, 33.5; in New York, 35.5; in New Jersey, 38.9. On the other hand, in New Hampshire it is 51.5, in Pennsylvania 56.1, and above 60 in the other states.

The foreign-born live chiefly in the cities and manufacturing towns. In certain sections of a few New England towns you may see signs in the shops, "English Spoken Here," but on the streets you will hear little English. In some sections of New York City and on certain streets of other Northeastern cities one hears little English, also. On the other hand, in the rural districts the native-born are in the majority, though in some districts there are many foreign-born farmers.

It is clear, then, that the people of the section are quite different in places of origin, religion and language from the population of a hundred years ago. We have not space to tell of all these differences here, but many books have been written on the subject, and you will learn more about them when you go to college.

In the old days the section as a whole was famous for its interest in education. In this there has been no change. More money than ever is spent for public schools, the section is full of famous private schools, and some of the most important colleges and universities in the land are here. Many draw students from far and near.

THE NEXT STORY OF THE UNITED STATES IS ON PAGE 4306.



Philip Gendreau, N. Y.

The lovely old town of Oberammergau, in the Bavarian Alps. This is the home of the famous Passion Plays.

THE STORY of GERMANY

HAD you visited Germany before the war, you would probably have gone by boat to either Hamburg or Bremen. These are old cities on the Elbe and Weser rivers, which empty into the same section of the North Sea. Then you would probably have taken a fast train to Berlin, the nation's capital, across very flat country. The stay in Berlin might have seemed uninteresting had it not been for walks down Unter den Linden, Berlin's wide thoroughfare of shops and government buildings, which leads from the Brandenburg Gate to the palace of the former Prussian kings, and for trips to the city's famous museums and theaters.

After Berlin, you might have visited some picturesque towns along the seacoast. Like Bremen and Hamburg, these once belonged to the Hanseatic League of free cities, so called because of the Hansa, or guild of merchants, which as early as seven hundred years ago built up a prosperous foreign trade. The timbered houses, quaint town halls, fashioned of dull red brick, and beautiful churches of these towns testify to their wealth and culture in those olden times. Lübeck, where the novelist Thomas Mann was born, Rostock and Danzig are the most interesting of the old cities. Still another historic town is Elbing, where a colony of English merchants settled in the days of Shakespeare. There are still some old seven-gabled houses in Elbing.

Turning southward, you would soon have discovered that the historic beauty of Germany as well as its modern industrial life were centered in the great river valleys. Farthest west is the Rhine, which countless visitors have enjoyed because of the romantic scenery along its banks. The lordly river, together with its tributaries, is also the nerve center of German industry.

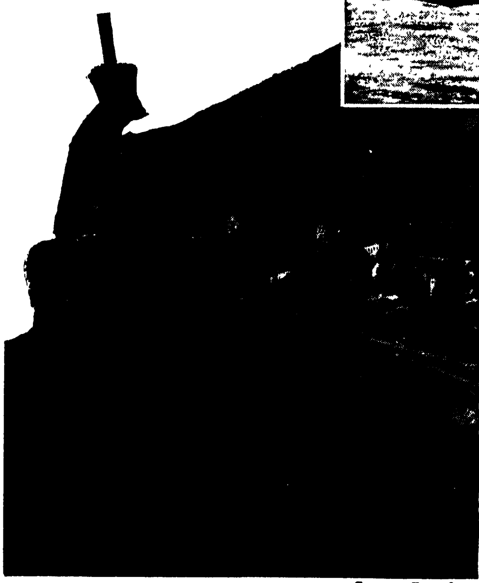
Cologne, the largest city in this valley, was once an ancient Roman town, from which the Emperor Augustus dispatched his legions to conquer the warlike German tribes

led by Arminius, in the surrounding forests. (But, as we tell you on page 1244, the Romans failed to conquer these fierce fighters.) Until the war against Hitler destroyed so much of it, Cologne had many beautiful buildings, among them churches almost a thousand years old.

Screen Traveler, from Gendreau

Terraced vineyards climb the steep hillsides that line the storied Rhine River along a part of its course.

A sluggish little stream called the Ruhr flows through rich coal-fields and empties into the Rhine north of Cologne. Near the point where the two rivers meet there are important manufacturing cities. One of them is Essen,



James Sawders

A Gothic figure guards the town of Cond, on the Moselle.

home of the German steel industry. Another is the great inland port of Duisburg. Relatively little iron is mined in Germany, so that industry relies on ore imported from France and Sweden and brought up the Rhine to the manufacturing cities.

Farther east, the Elbe and the Oder rivers cross Germany. These broad streams are waterways which for centuries past have carried German produce and manufactured goods to market. Along them many important cities were built. The Rhine, the Elbe, the Oder and most of the other rivers of Germany take a general northwesterly course, and empty into the North Sea or the Baltic.

There is at least one great exception, the Danube with its tributaries, which flows across half the width of Europe, taking a southeasterly course. The Danube is a small river at its source in the hilly, picturesque region of Württemberg, in southern Germany; but later on it becomes a mighty stream, the gateway to southeastern Europe. It empties into the Black Sea. The Danube is flanked over most of its course by mountain ranges, offshoots of the Alps and the Carpathians. Perhaps the best known of these ranges in Germany are the Bavarian Alps. Nestled in their valleys are charming old towns where time seemed to stand still—that is, before 1939. One of these towns was Oberammergau, where the Passion Play, relating the story of Christ's life, was performed reverently every tenth year by the peasants.

In modern times, Germany became an industrial country; and for generations past the majority of its inhabitants have made a living by working at coal mining, steel production, shipbuilding, and the manufacture of electrical appliances, textiles, machine tools and chemicals. These industries flourished partly by reason of the excellence of German training in the sciences. Never-

theless, interest in the handicrafts survived, and German workmen were probably unexcelled at such trades as the grinding of lenses, color printing and the making of precision instruments. Old arts likewise formed a basis for modern enterprise—doll-making, for instance. But although many people worked at trades as diverse as the manufacture of Christmas-tree ornaments and the carving of cuckoo clocks, such large numbers were dependent on the mines and the foundries that when these enterprises did not prosper mass unemployment resulted.

The German farmer, for his part, is more methodical and scientific than the French peasant. Like the French peasant, he is closely attached to the soil and to local custom. In some regions the ground he tills is fertile, but in general he must make a living in spite of many difficulties. The vineyards along the Rhine and the Moselle are good illustrations. Here the vines grow on little terraced plots that cover steep hillsides rising from the river valleys. Every foot is precious because the grapes ripen best in the sun as it beats upon the sloping ground. But earth washed down by the rains must be carried up again in baskets, and the ravages of winter have to be carefully repaired each spring. During many months the soil is tilled and the plants are tended by hand. Grape-picking time keeps whole families busy from morning till night.

James Sawders

A medieval air lingers in this old Bernkastel street.

Even more remarkable, perhaps, is the German farmer's success in growing on the sandy loam of the eastern districts large crops of potatoes, rye and sugar-beets. Just before the war, Germany's production of all cereal grains (except wheat) was greater than that of any other country except the United States and Russia. Thus Germany could almost meet its basic food requirements. The German farmer is normally loyal to his religion and his traditions. Peasant dress is worn in some regions. There are many different dialects, and a wealth of folklore.

THE ROMAN EMPIRE FAILS TO CONQUER THE GERMAN TRIBES

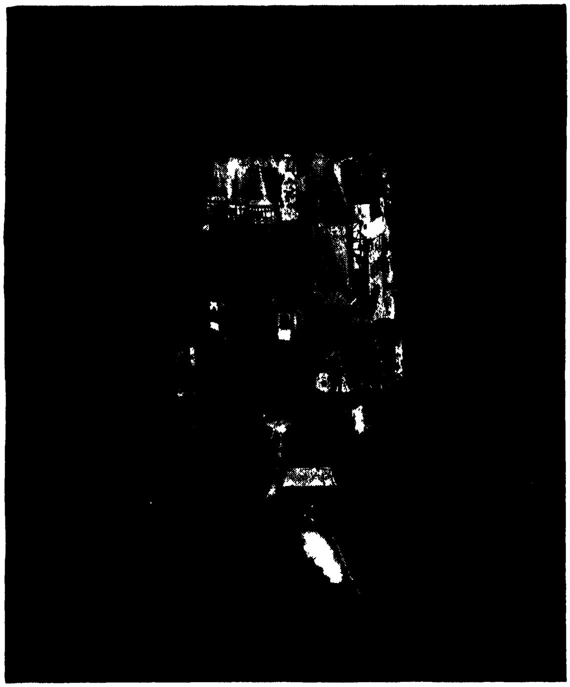
The course of life in Germany has been most affected by the geography of the country. In the time of the Roman Empire, civilization in Europe did not spread much beyond a strip around the Mediterranean Sea. Though the rule of the Caesars was established in northern Gaul and Britain, intellectual and artistic achievement flourished only within a sort of oval, the northern boundary of which ran through Cologne, while the southern boundary passed through North Africa. During the early years of the Christian Era, the Romans attempted to complete the conquest of northern Europe; but they failed. Then, to protect themselves again invasion, they built a fortified line, the so-called *limes,* which ran from north of Cologne eastward to Regensburg (Ratisbon) and Vienna. This was sufficiently sturdy to ward off attacks for 150 years; but when the strength of Rome ebbed and the great empire fell, the center of European culture was slowly shifted to the north.

The trend has persisted throughout modern history. This meant that Germany, having great harbors on the North and Baltic seas, as well as roads and waterways leading eastward from France, virtually controlled the lines of communication between the east and the west of Europe. This control was, of course, exposed to constant threat, and so the Germans tended to believe in military preparedness and to seek to extend their frontiers. On the other hand, they were also subject to influence from both sides, so that their culture has always blended Slavic and Western ideas.

We do not know a great deal about the ancient Germans, except that they were divided into many tribes. The people seem to have won a living from the soil and to

have put much emphasis on family life. Those who lived under Roman rule south of the *limes* rendered Europe an enormously valuable service by practicing the art of farming. Colonies of these farmers were settled by the Romans in various parts of the Empire, for instance in Spain, where they brought vast areas of waste land, which had never known a plow, under cultivation.

But the unconquered tribes north of the *limes*, though they had some contact with Roman civilization, were unable to establish a well-ordered society. Meager information about their religious beliefs and their military history can be gleaned from the German epics, notably the EDDA and the SONG OF THE NIBELUNGS. The tribes of eastern Europe, some of them Germanic, others Slavic, finally gained the upper hand, swept across Germany, and eventually invaded the Roman Empire.



James Sawders

A castle fit for the Sleeping Beauty, near the Moselle River, towers over the dense forest of the surrounding region.

Chaos followed the Roman collapse. Then came attempts of tribes known as the Goths, and later attempts of other tribes, the Vandals, to rule Europe. These drives had a very notable effect upon the development of central Europe. First, Slavic, Germanic and Celtic tribes became so interwoven that what might once have been called a "German race" ceased to exist. The territory east of the Elbe became predominantly Slavic, while the German tribes in the West pushed into France. Indeed, France gets its name from one of these tribes—the Franks.

Second, France provided the basis for a new social order. This came about through the conversion of powerful Germanic chieftains to Christianity. Religion now became the source of unity and order. In accordance with what they understood to be its teachings, Clovis and Charles Martel, leaders of the Franks, set about fashioning a kingdom. This took on definite form under Charlemagne (768-814). Having established the seat of his rule in Aachen, this truly great, if often merciless, king subjugated the Saxons and compelled them to accept Christianity. He also fostered the arts of peace. He believed in education and founded the first Christian schools in northern Europe.

Meanwhile the Church was dreaming again of a new Roman Empire in the West. The Franconian monarchy seemed to be the answer to its prayers. Mohammed had died in 632, and ever since his followers had waged war against the Western world. The southern shore of the Mediterranean was in Mohammedan hands, and those who sailed that inland sea were at the mercy of the fierce Mohammedan Turks. The eastern half of the old Roman Empire was without contact with the western. Under these circumstances, Christendom welcomed the strength of the Frankish kingdom.

Charlemagne was crowned Emperor of Rome in the year 800, and so there came into being the Holy Roman Empire. Efforts to maintain it were continued during many centuries. This empire was not a nation but a sort of federation of European peoples; and those who cherished the idea on which it was based were convinced that it made possible a Christian dominion in which peace could be preserved.

Unfortunately, Charlemagne's successors could not maintain the unity of the realm. Rival factions began to quarrel, and the various tribes fought and schemed against

one another. Finally, in 843, the Frankish and German portions of the Empire were separated. The German kingdom thus created was about the same in extent as the Germany which came into being temporarily as a result of the Pact of Munich (1938).

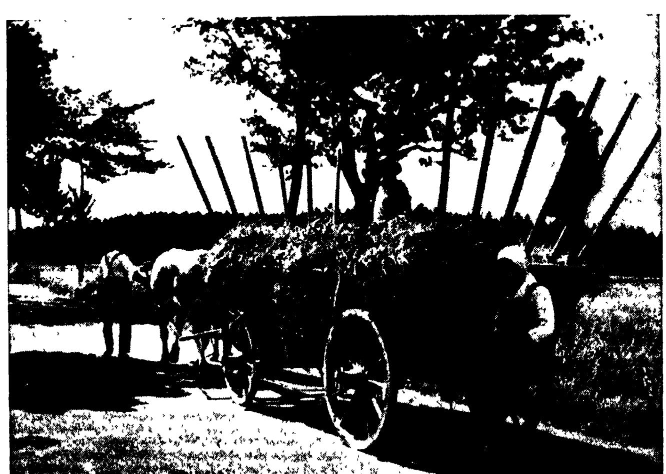
During several centuries thereafter, German rulers strove to retain control over the unruly noblemen who were their subjects and to preserve for their families the title to the Imperial Crown, which could be bestowed only by the Pope. First came a line of Saxon monarchs, notable for their energy, frugality and religious feeling. They thought of themselves, not as Germans, but as Christians to whom was intrusted the duty of supporting the work of the Church. Monasteries were founded in order to promote the conversion of the Slavic East, and a high spiritual fervor was fostered. The ruling classes of Germany gradually became deeply religious and interested in the welfare of Christendom as a whole. Unfortunately, in these feudal times the masses of the people were very badly off. They, less enlightened than the nobility, often practiced the old pagan religions side by side with Christianity.

After the line of Saxon kings came a number of Franconian rulers; they were of the Salic tribe, and so the line, or dynasty, is often called the Salic, or Salian, dynasty. The first two Salic emperors were strong and powerful, but the next one, Henry IV (1050-1106), was embroiled in conflicts most of his life. His heaviest struggles were with the Pope, who wanted to make certain reforms in the church government. Henry opposed them, since they interfered with some of his feudal privileges. There was a violent quarrel, but Henry was compelled to submit.

Tension mounted throughout the era of the Crusades. These armed expeditions to wrest the Holy Land from the Turks aroused strong popular feeling which sometimes found expression in fanatical excesses. Thus the Rhenish cities (cities of the Rhine) witnessed pogroms which led to the killing, expulsion or forced conversion of many Jews. On the other hand, many of the Crusaders themselves were affected by the moral laxity of the East. Others became deeply discouraged because, chiefly as a result of the breakdown of the transportation system, lasting victory over the Moslems was not achieved.

After the Salian emperors there was one more Saxon emperor, and then the Hohenstauffen dynasty. The most brilliant of the Hohenstauffen emperors was Frederick II (1194-1250), grandson of Frederick Barbarossa, one of the famous Crusaders. Changes in the German outlook are reflected very early in the life of Frederick II. Reared in Sicily, which had become a flourishing part of the Empire, he was educated by Greek and Arabian teachers. He knew several languages and understood science. He became an author and a lover of the arts. He was not a religious man, but he employed every ruse of diplomacy in his struggle with the Papacy, instead of quarreling. Frederick took little interest in the affairs of Germany, which he seldom visited; and so the German princes seized their chance to increase their power and influence. As a result, the unity of the Empire could not be maintained after his death.

Now the Papacy and its Italian allies were hostile to the Holy Roman Empire, for Frederick had created a state that was divorced from religious purpose; and, making Sicily the seat of his realm, he had intervened in every Italian quarrel. In Germany there were now so many powerful noblemen that the Imperial Government was

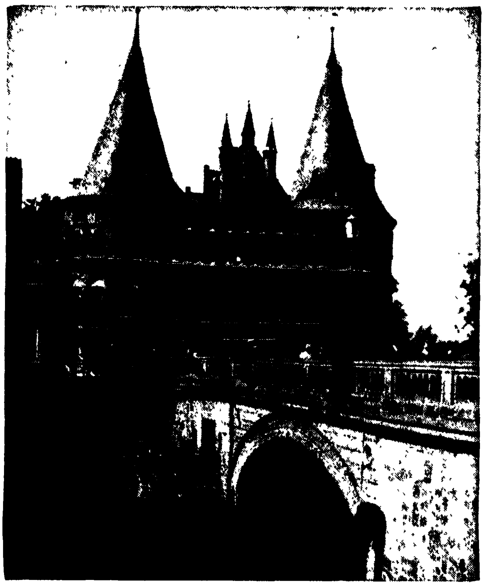


Philip Gendreau, N. Y.

Hauling hay in the Black Forest, in southwestern Germany. It is an enchanting region which casts a spell on all who visit it.

compelled to make more and costlier concessions to them.

After the death of Frederick II, the kingdoms and principalities of the Holy Roman Empire began to fall apart; and there was an Interregnum, as historians call it, lasting until 1273. Interregnum means a kind of recess. To be sure, there were emperors during the Interregnum, but they had no real power or importance; and although after the Interregnum the Empire again blossomed, it never regained the vigor of its early years.



James Sawders

The Holstein Gate, at Lübeck, built in the 15th century by Swedish conquerors. Entrance to the gate is below.

During the twelfth and thirteenth centuries, life in Germany was greatly affected by the rise of cities. Their fortifications, which were usually strong walls surrounded by moats, assured safety, and thus encouraged trade and industry. The homes of wealthier citizens were often several stories in height, beautifully adorned with ornamental woodwork, and capped with steep roofs. Hygiene and lighting were primitive.

Many of Germany's most illustrious churches, notably those of Mainz, Bamberg, Regensburg and Naumburg, were built, and to some extent adorned with masterpieces of sculpture, during this era. A stone figure that illustrates well the ideals of chivalry of the Crusades is the Rider in Bamberg Cathedral; and the twelve figures of Naumburg minster interpret the best in German medieval life with incomparable grace and depth. Saint Patrick's Cathedral in New York is fashioned after that of Regensburg.

The wealthier princes maintained splendid courts where religious devotion was ardently practiced, and where, at the same time, there was intense interest in the literary work being done in Italy and France. At Wartburg, which Martin Luther was to visit later on, Saint Elizabeth of Hungary, influenced by the followers of Saint Francis of Assisi, dispensed charity to the poor and set a far-reaching example. But, as Wagner's TANNHAÜSER reminds us, the courtiers listened also to the minnesingers, or poets of love, who sang the praises of fair ladies and in so doing proved that the German language could be used for noble poetry. It is unfortunate that Germany did not produce at this time a writer of the stature of Dante, the great Italian poet—one who could give lasting form to the common speech of the day. For the German language, as modernized later on, is relatively artificial. It has lost much of the vigor and sweetness of its origins.

During this medieval period the Teutonic Knights were organized. This was one of several military orders founded during the period of the Crusades. Those who became knights pledged themselves to live unblemished lives of service in accordance with a religious rule. Early in the thirteenth century, the Teutonic Knights were invited by the King of Poland to assist in subduing the Prussians, then a heathen tribe dwelling in the marshes and woodlands south of the Baltic Sea. This mission was successfully accomplished, and the Knights went on to colonize a vast area. They built towns, some of which were affiliated with the Hanseatic cities. They erected castles of which the Marienburg, just south of Danzig, is the most impressive example. And they Christianized the northeast of Europe. But in time they quarreled with the Polish sovereigns and were themselves weakened by worldliness and greed. The government they established was often oppressive. In their best days they were, however, gallant Crusaders; and they were well in advance of their age as engineers and colonizers.

THE HAPSBURGS, A GERMAN FAMILY, COME TO POWER

The Interregnum ended in 1273, when a Hapsburg prince was elected emperor. In the years that followed the crown passed

from one dynasty to another, to come back at last to the Hapsburgs. These princes had their seat in Vienna, Austria, and their task was to defend the boundaries of the realm in the west while warding off attacks by the Turks in the East. Austria controlled Burgundy, a dukedom in France, and to Burgundy the Austrians owe the social customs and manners that we think of as "Austrian" to this very day. Yet, because the power of the sultans was for so long felt as a threat to her eastern border, Austria came to be concerned with civilization in eastern Europe. Thus she looked both ways.

The rule of the Hapsburgs was never tranquil in the political sense, but well-being increased among the people nevertheless. This was the age of the guilds, those associations of master craftsmen to which central Europe is indebted for a great deal of its finest art and some of its most beautiful cities. (World War II unfortunately destroyed much of the legacy of the guilds; for example, the marvelous old streets of Hildesheim and Brunswick. Only a few of the old towns are relatively unscathed.) After the Crusades, Germany became a center of traffic between the East and the West. A rich trade in furs and damasks and spices assured the Western world of these luxuries, while textiles and other wares went from France and western Germany to the East.

Philip Gendreau, N. Y.

Holiday costume in the Black Forest. The girls wear fitted bodices and long embroidered aprons, carefully worked in vivid colors.

Meanwhile, older religious loyalties were being undermined. There were a number of reasons for this. First came a reform movement led by John Huss, a Czech theologian who was also a popular preacher. Huss was condemned to death and executed for heresy, whereupon his followers rebelled and were crushed in a bloody war. Then Martin Luther, an Augustinian monk, began to advocate ecclesiastical reforms. On October 31st, 1517, he nailed on the door of the ducal chapel at Wittenberg a scroll setting forth ninety-five theses which he declared himself ready to defend. Thereby the era of religious change known as the Reformation was inaugurated. The creed of the Reformers came to be known as Protestantism.

A movement within the Catholic faith, led by the Society of Jesus, followers of St. Ignatius Loyola, is termed the Counter Reformation. No compromise was reached, and Germany was divided into two hostile camps. Most of the North became Lutherans while the South largely remained Catholic. Sharp conflicts were frequent, and in addition a Peasants' Revolt, of which Luther disapproved, showed the general dissatisfaction and restlessness of the times.

Even so, the era witnessed a great increase of interest in civic affairs, as well as the growth of the middle class. In the arts, Germany was influenced in part by the Italian Renaissance, and in part by the genius of the Netherlands. This was an era of great masters. Beginning with Lucas Cranach, and continuing to Albrecht Dürer of Nuremberg, artists attained heights which Germans never again reached. Sculptors like Veit Stoss and Tilmann Riemenschneider, the second of whom is probably the greatest of German plastic artists, showed surpassing genius. One of the most original of German painters, Matthias Gruenewald, is also of this period. His masterpiece, still preserved in Colmar, is the triptych (a work of art on three panels, side by side) illustrating the Passion of Christ. This was a favorite form of religious art at the time.

Literature made great strides. Martin Luther's translation of the Bible did much to fix the character of the German language. The Jesuits, conducting schools in accordance with the educational philosophy expounded by their founder, made play-acting an important part of the course of study. The plays written and produced in their schools helped notably to prepare the way for modern drama.

In architecture, influences coming from Renaissance Italy soon gave way to a more ornate style known as the Baroque. As a consequence many German towns acquired variety and individuality. The older buildings of the Romanesque and Gothic periods were preserved, but churches, houses and civic buildings reflecting the new taste were

added, so that many cities took on an unusual charm. One has only to think of Munich and Augsburg, or of the abbey towns of southwestern Germany. People were prosperous and there was a greater measure of comfort than any earlier generation had known. Some prominent families were very wealthy and precious metals were used lavishly in making the furnishings, especially objects of art, for patrician houses.

James Sawders
Wartburg house where Luther translated the Bible.

This era of prosperity was ended by the outbreak of the Thirty Years' War (1618-48). In its earlier stages this destructive conflict, rooted in the rivalry between Protestant and Catholic princes, centered round the control of Bohemia. The armies of the Catholic emperor were temporarily victorious. There followed a war between the Germans and the Danes, which ended when the Peace of Lübeck was signed in 1639. During this conflict the imperial forces were for the most part commanded by Wallenstein, an able general of doubtful character (whom Friedrich Schiller, more than a century later, made the tragic hero of his greatest play). Soon a powerful Swedish army, commanded by King Gustavus Adolphus, invaded Germany in support of the Protestant forces. This army won notable victories but was defeated after the Swedish king had fallen in battle.

Then a Franco-Swedish alliance. sponsored by Cardinal Richelieu, waged war once again, and wrought terrible havoc in Germany. So many lives were lost and so much treasure was consumed that a universal longing for peace set in. The Treaty of Westphalia, signed in 1648, fixed the religious boundaries of the German states. It also, to a considerable extent, determined the outline of modern Germany. War was held in abhorrence by the German people for a long time; and plans for the preservation of peace were everyday topics of discussion. The most significant of these was outlined during the following century by the great philosopher, Emanuel Kant (1724-1804). He advocated a league of European nations pledged to settle disputes.

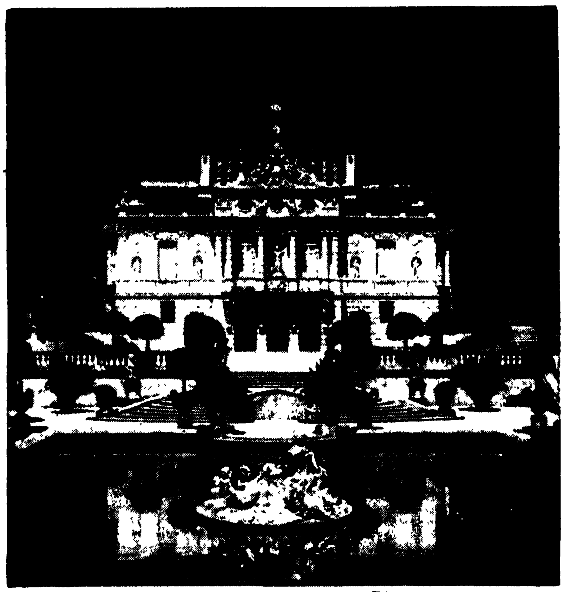
SEVENTEENTH-CENTURY GERMANY, A MIXTURE OF INDEPENDENT STATES

Germany was now (1648) made up of a great number of independent principalities, duchies and free cities. In the majority of these small states, a court was pledged to uphold the religion professed by either the majority of the citizens or by the ruler. There was practically no German literature, for the educated people preferred the Latin language. Many of the states were governed by absolute monarchs, who exercised unlimited sovereignty over their subjects. The proud burghers (independent city men) of previous centuries were almost extinct. Many Germans were actually sold by their princes to other nations as soldiers. You already know of the Hessians who served in the British armies during the American Revolution. These troops were recruited by force and shipped abroad.

France had become the dominant power on the Continent. The age of King Louis XIV (1638-1715) in particular was a period during which French taste and French ideas shaped the culture of a backward and poverty-stricken Germany. The Hapsburgs still were nominal rulers of the Empire; but very gradually the Kingdom of Prussia became powerful. This hitherto unimportant state consisted originally of the territory of Brandenburg in northeast Germany, and had been enlarged primarily through the purchase of territory from the Teutonic Knights. It was ruled by the Hohenzollern family; and at this point it was autocratically but frugally and efficiently ruled. A standing army was organized in Prussia because such a force was deemed to add luster to the ruling house.

It suddenly became evident that the little

state possessed a very gifted, cynical and, upon occasion, war-like monarch. This was Frederick II, called the Great (1712-86). He was also a dabbler in the arts, and a friend of the French philosopher Voltaire. Within a few years, Frederick had wrested the realm of Silesia from his rival, the Empress Maria Theresa of Austria, and had shared with Russia and Austria in the Partition (cutting up) of Poland. When Frederick the Great died in 1786, Prussia had become a strong and populous state. Frederick's principal cultural monuments were the Protestant and Catholic churches he caused to be erected in Berlin, and the Palace of Sans Souci, at Potsdam, built in the most agreeable French manner.



Philip Gendreau, N. Y.

This dazzling castle, in the heart of the Black Forest, contrasts vividly with its setting of green mountains.

Toward the close of the seventeenth century, the people throughout the German states began to recover a certain measure of prosperity. The southern regions of the country witnessed the development of an ornate architecture. Splendid monasteries, churches and palaces were erected. The traveler who has studied these great buildings can not forget the extraordinary skill with which the architects blended new ideas with what remained of an older art.

Perhaps the greatest builders of the period were the Brothers Asam, to whom we owe, for example, the Church of St. John Nepomuc, in Munich. But there is scarcely a South-German town or shrine which does not owe some miracle to this inventive age. The convent church of Wies, in Bavaria, for example, is surely one of the most interesting minor buildings of the period.

Literature, too, slowly revived. During the eighteenth century there was a rebirth of German poetry, influenced greatly by English models. Heights attained neither before nor later were scaled in the work of three masters—Goethe, Schiller and Hoelderlin. Johann Wolfgang von Goethe, the greatest of German humanistic genuises, was born in Frankfort, but spent most of his life (1749-1832) in the town of Weimar. FAUST, his most important philosophical drama, is the supreme masterpiece of German literature. It is a sort of panorama of the human soul in quest of certitude and peace, despite the constant torment of desire. Goethe was also one of Germany's most creative lyric poets, and perhaps its greatest novelist.

Friedrich von Schiller (1759-1805) was a South German devoted to the ideal of freedom. He exercised a profound influence upon later generations of Germans. During many decades Schiller was the poet from whom young Germany learned a code of idealistic service. Friedrich Hoelderlin (1770-1843), also a South German, was less well known during his lifetime than were many of his fellow-poets. Yet he is possibly the foremost lyric poet of the German people, though he is not the easiest to understand.

The period after the Thirty Years' War witnessed the magnificent development of German music, under the patronage of princes and aristocrats. The first illustrious master was Johann Sebastian Bach (1685-1750), writer of both choral and instrumental music, and a man of singular sweetness and nobility of character. His music remains, in the opinion of many students, unsurpassed for richness and depth. In the United States, no pains are spared to make the annual Bach Festivals the most significant events of their kind.

The work of Bach inspired such eminent composers as Handel (1685-1759), Haydn (1732-1809) and Mozart (1756-91). To them humanity owes an art of magnificent intricacy, which has cast its spell upon every

generation since their time. Mozart was also the first great writer of German opera. These three were followed by Ludwig van Beethoven (1770-1827), a genius whose work, which includes virtually all the musical forms, contains both the legacy of the past and the promise of the future. The technical means available to these great musicians were relatively meager. Bach used a pipe organ which was spare and simple when compared with the lavish instruments of later times. The spinets which Mozart and Beethoven knew were very modest precursors of the modern piano.

Thus, despite its lack of political organization and the bleak poverty of many of its people, Germany had become, at the close of the eighteenth century, the home of great poets, artists and thinkers. For the most part, such men were dependent upon the good will of some prince who desired to grace his court with the prestige of their names. On the other hand, many of the monarchs were willing to accord liberty of expression to men of genius and talent.

Then the long process of political change in France, to which the name of French Revolution is applied, had its turbulent beginning. It was welcomed by many German intellectuals, but opposed by the rulers, who strove to defend the cause of Louis XVI and his Austrian-born queen, Marie Antoinette. An alliance entered into by Austria and Prussia in 1792 constituted a threat to the newborn French Republic. France introduced conscription, declared war and forged a great and enthusiastic army on the anvil of national sentiment. After Napoleon Bonaparte assumed command of this army, the defeat and virtual conquest of all Germany began. Bavaria and other South-German states became allies of Napoleon. In Austria and Prussia, however, a fierce desire for liberation was enkindled.

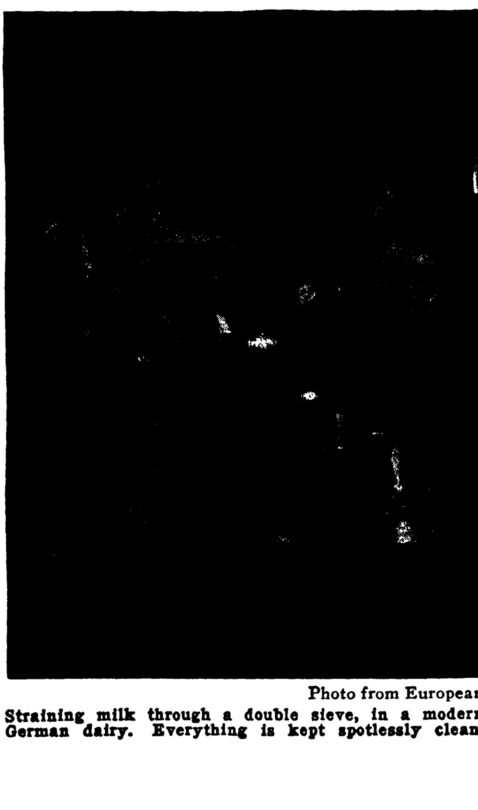


Photo from European

Straining milk through a double sieve, in a modern German dairy. Everything is kept spotlessly clean.

First some of the Austrian mountaineers rallied round the Tyrolese patriot, Andreas Hofer; but they were defeated after a number of indecisive victories. Hofer, captured and executed by the French, became an Austrian national hero. Next, the Prussians rose in 1813, but they lost two bloody battles to Napoleon. The cause of Germany seemed hopelessly doomed, though the resolute spirit of its best men did not flag. After Napoleon's retreat from Moscow, a grand alliance brought Prussia, Austria, Russia and England together. The French emperor was then defeated at Leipzig and forced to retreat to France. Eventually he was beaten soundly by the Allies at the Battle of Waterloo (1815).

In this fighting a new Germany had been born. It had made heavy sacrifices for liberation and now it desired the unity of all Germany under a constitutional monarchy. It had been deeply influenced by the French Revolution, and by such liberal German philosophers as Fichte. Now thinking Germans in all the states sponsored an ambitious program of liberal reform.

THE CONGRESS OF VIENNA HALTS THE MOVEMENT FOR A UNITED GERMANY

But the peace conference, known as the Congress of Vienna, doomed these hopes to extinction. Austria and Prussia did not merge; but each was bent on enlarging its own territory. And, in fact, both succeeded. In both countries, a reactionary monarchist government gained additional strength and paid only lip service to the plea for more democratic government. Prussia did not receive the constitution which its ablest citizens desired, although Baron Heinrich von Stein succeeded in reforming local administration. In short, the Holy Alliance, as it was called, of the four victorious powers—

James Sawders

An arithmetic lesson in a country school in Bavaria. The children are using old-fashioned slates; and all the little girls have their hair braided in pigtails.

Austria, Prussia, England and Russia—prevented the creation of a new and liberal Germany.

This was a fateful hour in modern Germany. The demand for unity and reform did not cease, but hopes grew dim except in intellectual circles which formed particularly in the more liberal-minded South-German cities. Some good resulted from the rule of Napoleon. For one thing, the Jews were given an equal status.

Meanwhile, the way of life was everywhere changing, as inventions threw out hand work in many lines and set factories running in town after town. The differing interests of capital and labor began to show up. Both business men and spokesmen for labor began to be heard. Ferdinand Lassalle (1825-64) sponsored a movement to foster state socialism. He was followed by Karl Marx (1818-83), who was led by a study of industrial conditions in England to proclaim a doctrine of class warfare. Similarly, a strong movement to effect social reforms developed in the Catholic regions of western Germany.

Public sentiment asked for a "parliament" to organize constitutional government for a unified Germany. After much preliminary discussion, a National Assembly met in Frankfort during May, 1848. It adopted a bill of rights and wrestled earnestly with the problem of Germany unity. But a series of unfortunate events led to the defeat of the liberal cause. Uprisings in various parts of the country were put down by troops. The principal revolutionists of 1848 sought refuge abroad; and many came to the United States. Among these was Carl Schurz, friend of Lincoln.

Prussia next stood forth for German unity. At first her motive was a real desire for liberal government. Then (1862) Prince Otto von Bismarck was appointed president of the Council of Ministers by the Prussian king. This able, resolute and often unscrupulous man turned Prussia from the liberal way. He served the cause of conservative Prussianism without restraint.

Bismarck was lucky. A victorious war with Austria was followed (1870) by the outbreak of war with France. The result was a dazzling triumph for Bismarck, and for Prussia. Under the leadership of General von Moltke, the armies of the German states, marching side by side for the first time, crushed the French forces opposing them in the bloody Battle of Sedan. France, still weakened from the Napoleonic Wars, was not able to carry on. She sued for peace.

The treaty was signed at Versailles, near Paris, and the terms, dictated by Bismarck, were pitiless. France had to sign Alsace and Lorraine over to the German Empire, a new, powerful organization of the German states created there at Versailles. The Prussian king became the first emperor, or Kaiser, as Wilhelm I. The constitution which Bismarck gave to the new empire assured the supremacy of Prussia inside Germany. Bismarck himself became chancellor, a position in which he was able to exert great power. The Iron Chancellor, they called this stern man.

Artistic and intellectual life between about 1830 and 1871 lacked much of the simple greatness of the age of Goethe. Nevertheless, it was rich and varied. The poets and thinkers of the time of the wars against Napoleon were followed by others who gave their hearts and their genius to the cause of freedom at home. These belonged to many groups. Heinrich Heine, author of some of the best-known lyrics in the German language, was Jewish; while Joseph von Eichendorff, who lived at the same time, was a great Catholic poet of southeastern Ger-

many. Among the younger men who were passionately interested in the outcome of the Revolution of 1848 was Richard Wagner, later on to become one of the most illustrious creators of opera.

So now, after the Versailles Treaty of 1871, the Germans were united. It appeared that they had secured union under a constitutional monarchy by reason of a successful war. This gave rise to a militaristic spirit destined to have the most somber consequences. Many Germans reveled in the feeling of strength, and applauded the iron discipline which they deemed responsible for the victories gained. Bismarck, it is true, believed that the new German Empire was sufficiently powerful; and he strove earnestly to maintain the balance of power in Europe. He courted the good will of Russia, Great Britain, and even France, while at the same time he strove to make the Prussian way of life dominant inside Germany. That he did not succeed in the second endeavor was largely due to the savage, but unprofitable, attack he waged on the Catholic Church. This episode is known as the *Kulturkampf*.

Then (1888) the Kaiser Wilhelm II came to the throne, and almost immediately declared himself at odds with Bismarck. The great Iron Chancellor was compelled to resign. He was followed by a series of weak statesmen who attempted, on the one hand, to carry out the Emperor's blindly unreasonable policies, and, on the other hand, to soften the effect of his foolish and warlike speeches. Wilhelm was not without intelligence and shrewdness, but he was unbalanced, abnormally sensitive, and influenced by romantic and dangerous ideas. Thus he became interested in the doctrine of Aryan supremacy put forward by the Englishman, Houston Stewart Chamberlain.

The ablest chancellor of this period was doubtless Bernhard von Buelow (1849-1929). He seems to have been guided by the belief that so powerful a state as Germany should not court the good will of other countries but should select, from offers made by others, the most suitable friends. In order to get such offers, Germany relied on stressing its might and its willingness to fight. As a result of this arrogant attitude, the British Government, which had sought an alliance with the German Empire, turned instead to France. England and France formed a friendly sort of agreement, called the Entente Cordiale, in 1904.

Kaiser Wilhelm was now building a strong navy, possibly to impress the world with Germany's strength, possibly merely to impress his British royal relatives with his grandeur. (Wilhelm was a grandson of Queen Victoria, and therefore a nephew of King Edward VII.) You may be sure the German fleet which was being built just across the North Sea was noted by the British public. Meanwhile, relations with Russia had likewise grown less friendly and even the German position in Turkey was open to serious doubt. When Buelow was followed (1909) by Theobald von Bethmann-Hollweg, it was plain that the only ally upon whom Germany could rely was Austria.

Meanwhile, changes of great importance had taken

James Sawders

Rocking-horses to prance under the Christmas trees of happy children. They are being carved in Munich, Bavaria, which is a center of the wooden-toy industry.

James Sawders
German porcelain is justly famous. Here the fragile figures are delicately tinted.

place inside the German Empire. Bismarck had skillfully prevented the various political parties from joining together against him; so his rule had been virtually unchallenged. Buelow, however, formed a bloc (union) of parties. This served temporarily to further his ends; but it also taught the German Reichstag (legislative assembly) the way to secure measures the people wanted, even against the will of the Emperor. If several parties, each one too weak to pass a bill alone, formed a bloc, or coalition, they could muster more votes in the Reichstag than the conservative "Emperor's party" could show.

The Socialist party grew increasingly strong, but fear of its influence and dislike of its programs induced a large section of the German farm population to organize and associate with the Conservatives. Thus the German party system became increasingly complex; but the country was nevertheless slowly turning to responsible parliamentary rule.

The years after 1870 were marked by changes in thought among the people. Education improved, but it seemed to be putting material things above spiritual welfare. There was an intense interest in science. Religion as a guiding force declined in many areas. Life at the courts was without intellectual luster, and suffered by reason of the harsh formalism of the military caste. Bad manners in Berlin and elsewhere did not destroy the courtesy and simplicity of German folk life. But brawls among student fraternities were common, and duels were regarded as honorable. It was a "class" society, with the high military officers at the top.

Toward the close of the century a significant change set in, both in scholarship and in the creative arts. Stefan George, Rainer Maria Rilke and Hugo von Hoffmansthal are among the great German poets of the time. Scholars like Ernst Troeltsch and Adolf Harnack opened new vistas to the mind. German youth, turning once more toward the idealism of Schiller, became deeply critical of the formalism and thin materialism of German life under the Empire. Thomas Mann in subtle and discerning novels described the slow decay of the middle class; and in Käthe Kollwitz Germany had a sensitive artist able to portray the longings of the masses.

Then, during the summer of 1914, storm clouds began to form over Europe. On June 28, Archduke Franz Ferdinand, heir apparent to the Austrian throne, was murdered at Sarajevo, a Serbian town. Count Leopold Berchtold, Austrian foreign minister, regarded the assassination as a reason for curbing Serbia, the ambitions of which were viewed with alarm by the Hapsburg Empire. Berchtold discussed the matter with Kaiser Wilhelm II and the German Chancellor, who agreed that stiff demands should be sent to the Serbian Government. Learning of this action, the Russian Government intervened, declaring that it would not countenance any threat to Serbia (like Russia, a Slav state).

Before issuing this warning, the Russians had conferred with the government of France. Now the Russians ordered their troops to be mobilized (made ready for possible war). Kaiser Wilhelm was now aware of the seriousness of the situation. He endeavored to induce the Russians to

countermand their order of mobilization. In this he was unsuccessful; and his chancellor was equally unsuccessful in an attempt to soften the demands of Austria.

The results of German diplomatic blundering after the days of Bismarck were now apparent. The only dependable ally was Austria; and so Austria could not be left in the lurch. On the other hand, Austria had been so impressed by German bluster and arrogance that she seemed to be acting in the spirit of Berlin. On July 31 Germany proclaimed a "state of war"; and by August 4, Germany and Austria were committed to war against Serbia, Russia, France and Great Britain. No one foresaw what the conflict thus started would ultimately cost in blood, treasure and social stability. In many countries, soldiers sang and laughed as they left for the front. Each nation believed in the righteousness of its cause. And yet each bore a heavy measure of responsibility for the catastrophe which soon engulfed the world.

The Germans must be blamed particularly for the unfriendly, saber-rattling policy of Kaiser Wilhelm, because this policy had helped to divide Europe into hostile armed camps. Now the German High Command added heavily to German guilt by marching into neutral Belgium. General Alfred von Schlieffen, chief of the German General Staff, prior to 1906, had devised a plan for defeating the French army in case Germany were attacked from two sides. This plan called for a flanking movement through Holland and Belgium. It was now changed to provide for a passage through Belgium only. The Belgians offered fierce resistance, and the civilian population suffered grievously. When the German chancellor, Bethmann-Hollweg, referred to Belgian neutrality as a scrap of paper, public opinion throughout most of the world turned against the Germans.

German armies defeated a French attempt to invade Alsace, and sent a powerful force wheeling southward toward Paris. French and British forces rallied, however, and in a series of engagements known as the Battle of the Marne brought the Germans to a halt. Meanwhile, the Russians drove into East Prussia, but failed to take advantage of their opportunity. Commanded by Generals von Hindenburg and Ludendorff, German troops overwhelmed a great Russian army at Tannenberg. During more than three years thereafter, in the east the line of battle moved to and fro. On the western front fighting was back and forth over a narrow belt. Millions of French, British and German troops fought and died in the mud and filth of trenches, expending precious life-blood on offensives which gained only a little battered ground.

In the spring of 1917, events began to move faster. In March a revolution broke out in Russia. The new government, headed by Alexander Kerensky, remained friendly to the Allies. But General Ludendorff, now virtually the dictator of Germany, carried the exile Nikolai Lenin (a disciple of Karl Marx) to Russia from Switzerland. In a short while Lenin and his followers ousted the Kerensky Government and decided to take Russia out of the war. So they asked Germany for peace terms.

Meanwhile, however, the United States Government had become involved in a dispute with

Photo from European

"Flour" from wood, a German wartime "ersatz," or substitute, product.

Germany over the conduct of submarine warfare. President Wilson asked Congress to declare war on Germany, and such a declaration was made on Good Friday, April 6, 1917. Fresh and powerful American armies landed in France, and the United States Navy started

James Sawders
Logs being floated down the Main River, through the lovely Bavarian countryside. This region is thickly forested.

to cope successfully with the German submarines. The Germans launched a final great drive on the western front during March, 1918; but this failed, and heavy pressure began to force them back toward the Rhine.

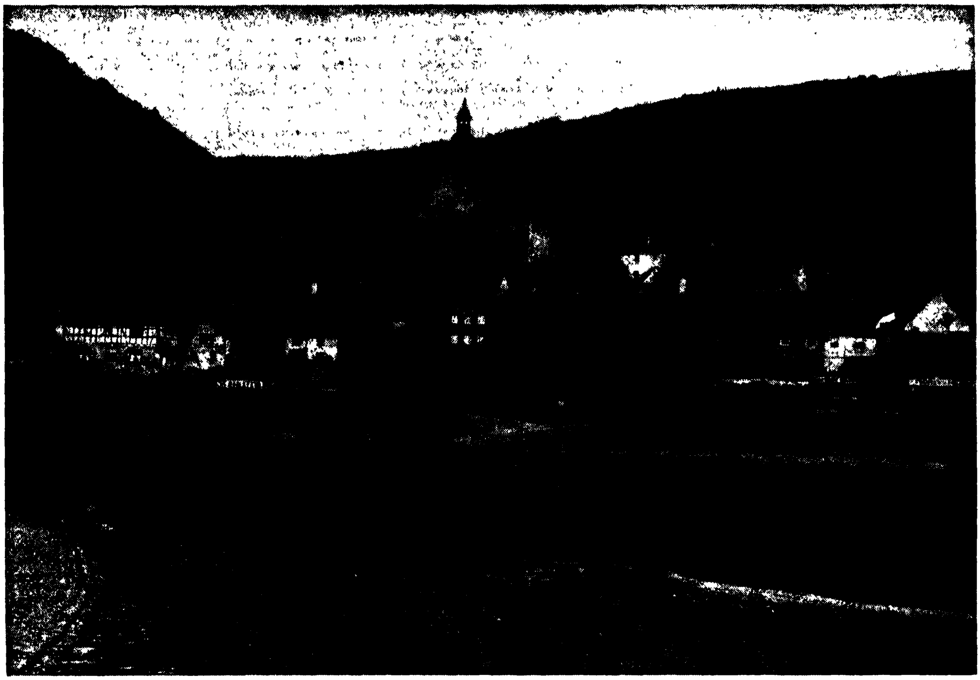
At the request of Ludendorff, who admitted that the war had been lost, a new German Cabinet, headed by Max von Baden, sued for peace. The Kaiser fled to Holland; and on November 11, 1918, the German Army was granted the armistice which its High Command had requested. An armistice is a temporary stop in fighting. In this case, fighting was never resumed. There could be no doubt that after four years of battle in the east and the west, the Kaiser's powerful military machine had been badly beaten. It had no reserves of man-power, its supply problems could no longer be solved and it was without either tanks or an ade-

Screen Traveler, from Gendreau
Modern highways were built all over Germany under Hitler—not for travelers, but for the rapid transport of armies.

quate air fleet. The people at home were in grave danger of starvation. On the other hand, the morale of the troops was actually better than the High Command supposed.

The change back from war to peace in Germany was chaotic. A sort of revolution was attempted by left-wing labor groups, impressed by the victorious revolution in Russia. This was opposed by the trade unions which were promised the support of the High Command in maintaining orderly government. A republic was proclaimed, but for some months violent fighting raged in various parts of Germany. Sometimes the government in the towns broke down completely. The transportation system and the distribution of food and fuel were seriously impaired. In addition, the terms of the Armistice imposed heavy burdens which further drained the resources of the country.

Nevertheless, the officials succeeded in restoring order and conducting a free election of delegates to a National Assembly which was to write a constitution and form a government of and for the people. Desire to create a democratic Germany was general and sincere. To be sure, a strong monarchist faction still existed, but there was a great democratic majority, led by men with experience in government. They may not have



In the little town of Beilstein, on the Moselle River, steep, gabled roofs stand out against terraced hillsides.

Both pictures, James Sawders

Peat is an important fuel in Germany. After it is dug up, the brick-shaped pieces are dried in the sun. This is hard work, especially for women, as the "bricks" of peat are heavy.

been brilliant, but they were inspired by sound patriotic motives. The constitution, adopted at Weimar, was genuinely liberal; but it had grave faults which would be revealed later on during years of stress and strain.

The new Weimar Government was forced almost immediately to deal with problems of the utmost magnitude. First was signing the citizen's budget; industry could be brought back to peacetime use only very slowly; and the general tension and bitterness resulted in a trend toward radicalism which threatened the republic.

There was another difficulty, arising from the class society of the past, which still, to some degree, lived on. Friedrich Ebert, the first president, had once been a saddler

Philip Gendreau, N. Y.

A glimpse of the Middle Ages, along the streets of Rothenburg, Bavaria. There are several gate towers like this.

the Treaty of Versailles. There can be no doubt that the effect of this treaty inside Germany was a serious obstacle to democratic government. The Allies imposed hard terms upon the conquered foe; and those Germans who were not in sympathy with the democratic way of life blamed the new government for agreeing. It did not matter that the High Command bluntly stated that Germany had to submit—she was unable to fight.

Though some of the demands for territory made by the Allies aroused strong resentment, it was the size of the reparations which caused the greatest dissatisfaction. Food and other supplies could no longer be procured, except at prices which strained (leather-worker). He was a man of excellent common sense and strong character, but neither he nor most of his associates had the aristocratic background of the old-time German officials. A government in which labor unions played a dominant part could not find many trained men for important positions of state unless it accepted the co-operation of more conservative groups.

In addition, the Treaty of Versailles permitted a German army of 100,000 men. This standing army, popularly known as the Reichswehr, remained conservative, even reactionary, and was in a position to aid discontented veterans who were trying to maintain secret military organizations.

The third major problem was created by

the decision of France to occupy the Ruhr Valley and seize German mines and industries there as pledges for the payment of reparations. The Germans countered this move with passive resistance, which ended by completely undermining their currency. The mark ceased to have any real value when, in December, 1923, it was worth only one-billionth part of what it had been worth before the war. Speculation was unrestrained. The middle classes were reduced to absolute poverty, and the whole social structure of Germany changed without benefit except to a very few profiteers. Resentment reached feverish heights.

AN OBSCURE AUSTRIAN, ADOLF HITLER, BECOMES THE LEADER OF A NEW PARTY

Many now sought to become spokesmen for the dissatisfied and disinherited. Among them was one who at first seemed insignificant. His name was Adolf Hitler, an Austrian who had served as a lance corporal in the German Army, and was now in the pay of the Reichswehr of Munich as a propagandist and spy. Hitler made influential friends, notably General Ludendorff; and he attempted to seize power in 1923. Such an attempt is called a *Putsch* (push) in German. Hitler's *Putsch* was easily put down, and for some years thereafter Hitler was little noticed. He was in prison for a while. He was persistent, nevertheless, and the organization of his party, National Socialist (shortened to Nazi), went on side by side with the organization of the equally extreme Communist party.

German finances were aided by loans from the United States, and between 1924 and 1929 the country enjoyed a period of relative tranquillity and prosperity. Industries were modernized and public utilities improved. The Government encouraged and aided housing projects. The inflation had virtually wiped out the class that lived on income. By 1928 approximately half the population (32,500,000 men and women in terms of official statistics) were gainfully employed. Of these, 29,500,000 earned less than 200 marks, or $50, a month. From these earnings taxes and social security were deducted. In view of the social benefits he enjoyed the German citizen was not too badly off, but he rarely had any savings. It was clear that if unemployment should increase very much, or if the flow of foreign credit should cease, there would be trouble.

When the great depression started in America in 1929, German business and credits were affected and unemployment began to increase rapidly. Soon a depression of terrible magnitude compelled the German Government to resort to drastic measures, partly in the hope of settling once and for all the reparations question. Unfortunately, the machinery of international discussion could be got into motion only very slowly. The president of Germany at this time was the former Field Marshal von Hindenburg, grown very old. The real power was in the hands of the chancellor.

During this crisis the Hitler movement, as well as the Communist party, began to grow. The Hitlerites profited especially by the fact that young voters going to the polls for the first time were attracted by the uniforms, stipends (small salaries) and ceremony of the party members. The generation born during the war was coming of age. An astute journalist had predicted that by 1930 these voters would elect more than 100 Nazis to the Reichstag. This prophecy was based on insight into the mind of a generation that had grown up amidst violence, inflation, disorder and bitterness. Too much stress can not be laid upon the destiny of these young people. Even although the nazi movement was the creation of discontented World War veterans who could not find their way back into civilian life, it was youth that transformed the movement into a strong party.

Further support came from quite different quarters—from certain sections of the steel industry, and from industrialists and Junkers (owners of big country estates). These men believed in a "corporative" social order which, they frankly admitted, would have to be established by the aristocrats and the employers. Thus they favored throwing democracy out the window. A favorite argument was that a nation's industry could not earn the social benefits desired unless it were so conducted that there would be "enough left over" to pay the cost of welfare institutions. Business men who held this idea, imagining they had induced Hitler to agree, aided the nazi cause.

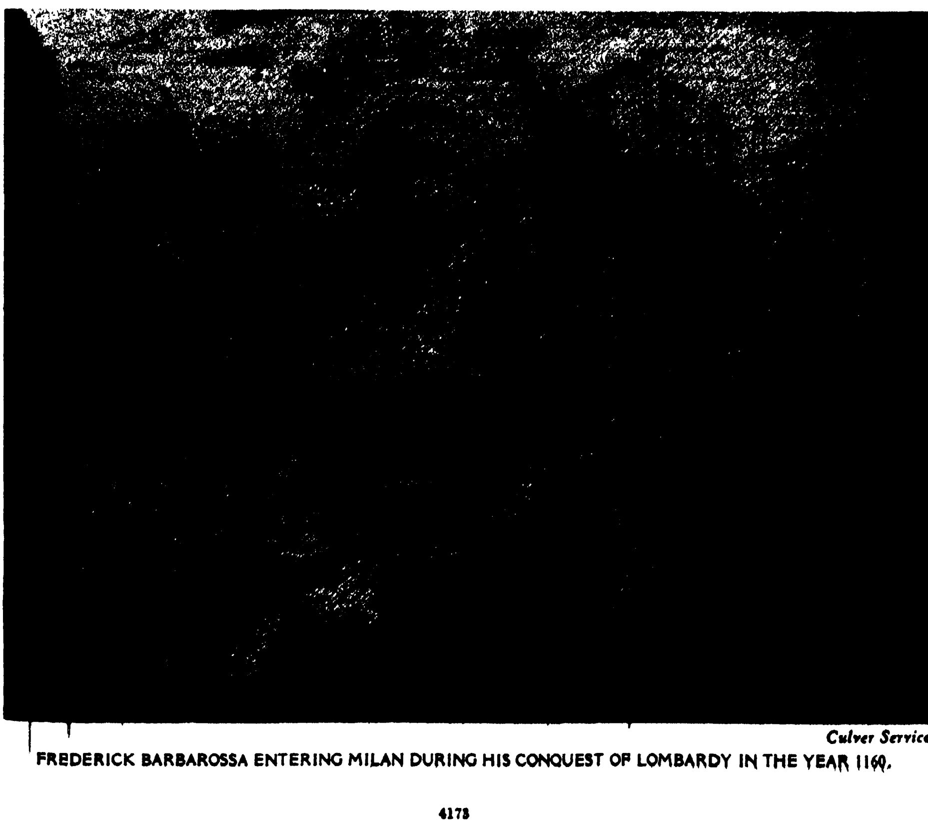
THE 1930's SEE THE RISING TIDE OF NAZI MIGHT

In the fall of 1930, 107 nazi delegates were elected to the Reichstag. From that time until January, 1933, when Hitler was named chancellor, the tide of radicalism grew mightier in Germany in spite of occasional setbacks. Many German voters got the impression that they must choose one

FATEFUL SCENES IN GERMANY'S STORY

Gramstorff Bros. Inc., Malden, Mass

ARMINIUS RETURNS FROM HIS VICTORY OVER THE LEGIONS OF ROME IN TEUTOBURG FOREST



Culver Service

FREDERICK BARBAROSSA ENTERING MILAN DURING HIS CONQUEST OF LOMBARDY IN THE YEAR 1160.

From an old print

THE DEATH OF GUSTAVUS ADOLPHUS AT LÜTZEN, WHERE SWEDES AND GERMANS DEFEATED WALLENSTEIN.

Frederick the Great, King of Prussia, at the Battle of Leuthen in 1757.

Culver Service

The Great Elector of Brandenburg, Frederick William, who helped build Prussia.

Culver Service

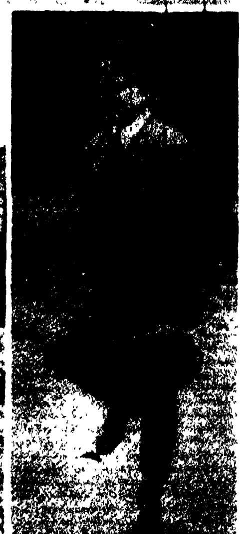
THE VICTORIOUS BISMARCK AND THE VANQUISHED NAPOLEON III MEET AFTER THE BATTLE OF SEDAN.

Culver Service

KING WILLIAM OF PRUSSIA IS PROCLAIMED EMPEROR OF GERMANY AT VERSAILLES, FRANCE, IN 1871.

Above: the German Kaiser, his son, the Crown Prince, and officers of the high command during the War of 1914-18. At the right: Adolf Hitler, leader of the Germans in the War of 1939-45. Below: German soldiers, captured by the Allies at Goch, in the great invasion of the Rhineland early in 1945.

Photos at right and below, Press Association, Inc. and British Official



THEY DREAMED OF CONQUEST

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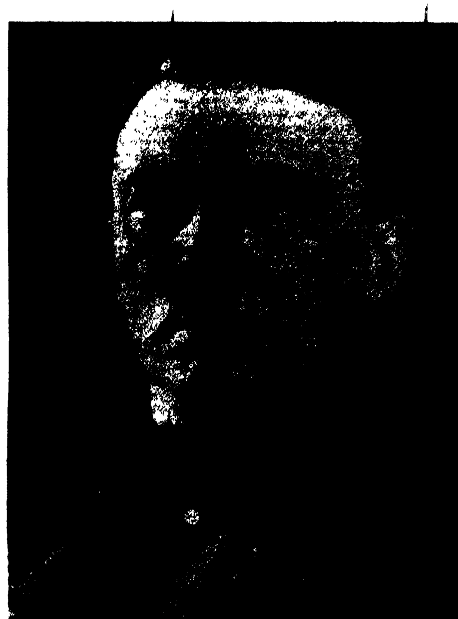
BISMARCK THE STATESMAN AND MOLTKE THE STRATEGIST CREATED THE MODERN GERMAN EMPIRE.



Culver Service *International News*

KAISER WILHELM II AND REICHSFUERER HITLER, WHO SET OUT TO MAKE GERMANY MASTER OF THE WORLD.

CITIES, SHIPS AND MEN OF THE

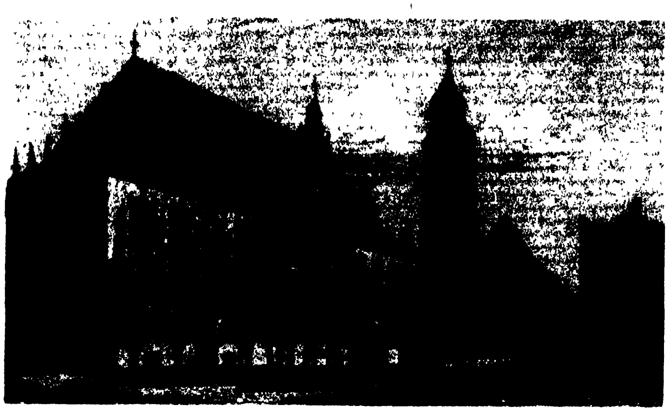
The walled town of Dortmund, one of the Hanseatic cities, as it looked in the 16th century.

Culver Service

The free cities of the Hansa, a guild of merchants, had more power than some kingdoms had.

The Bettmann Archive

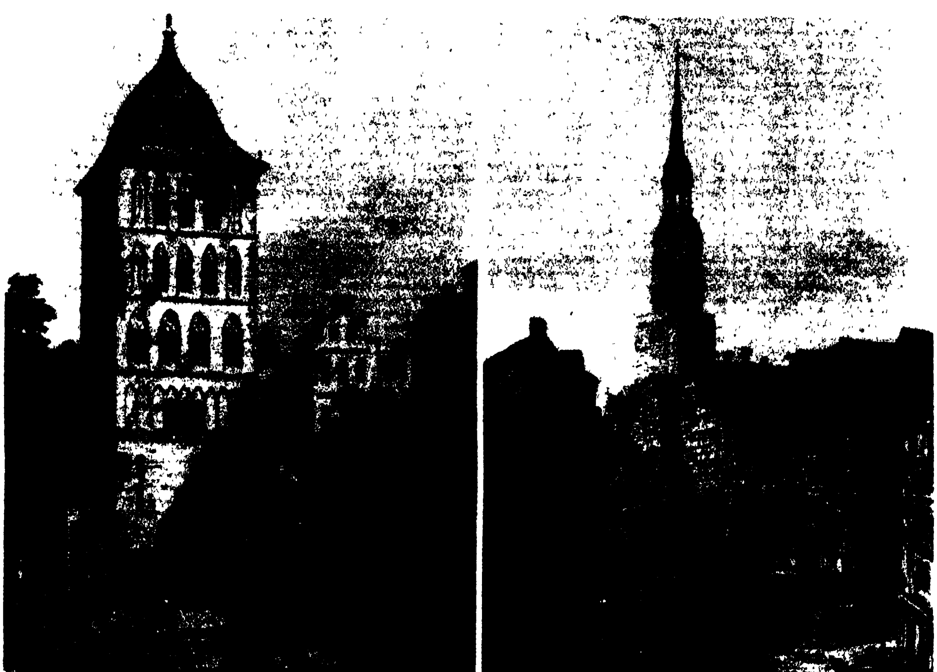
Above: a session of the Hanseatic League in the City Hall of Bremen, with delegates from the other cities.



Right: The City Hall of Bremen, where the meetings of the Hansa were often held in the League's great days.

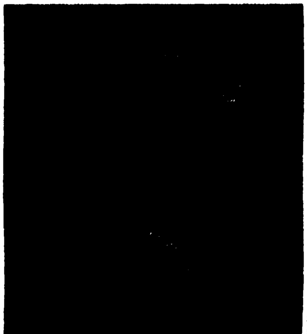
ALL-POWERFUL HANSEATIC LEAGUE

THE MERCHANT NAVY OF THE HANSEATIC LEAGUE WAS MADE UP OF SUCH FRAIL, CLUMSY VESSELS AS THIS.

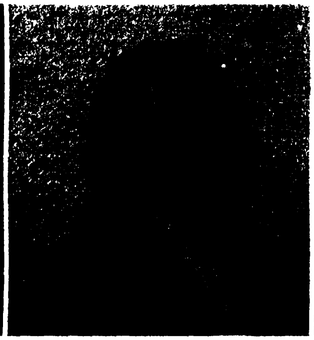


GLIMPSES OF LÜBECK (LEFT) AND HAMBURG (RIGHT), TWO IMPORTANT CITIES OF THE HANSEATIC LEAGUE.

ON GERMANY'S HONOR ROLL



IMMANUEL KANT.

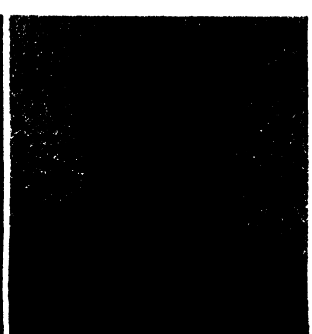


JOHANN SEBASTIAN BACH.

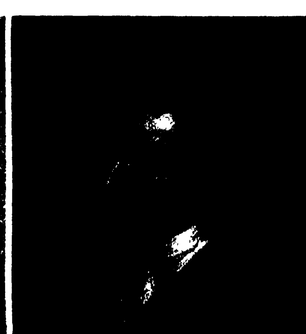
JOHANN WOLFGANG VON GOETHE

LUDWIG VAN BEETHOVEN IN HIS STUDY.

JUSTUS VON LIEBIG.



HERMANN VON HELMHOLTZ.



JOHANN C. F. VON SCHILLER.

extreme or the other—communism or nazism. Only the trade unions and religion were any longer able to muster support for a moderate position.

Just before new elections were held in March, 1933, the Reichstag was set on fire, probably by Nazis. Hitler blamed the Communists. The fear of communism, which had been present from the very beginning of the Republic, was now stronger by reason of constant street fighting and political agitation. This anxiety served as the excuse for suppressing the Communist party by decree. The elections, marked by tumult and bloodshed, were held in an atmosphere of high tension, with nazi storm troopers patrolling the streets. When the ballots of those who were still allowed to vote were counted, the Nazis and their conservative allies were found to have a meager majority of 52 per cent.

OPPOSITION IS BEATEN DOWN BY A REIGN OF TERROR

No sooner had the results been announced than a reign of terror commenced. Marxists (Communists), Jews, Catholics and pacifists were tortured and beaten; murder was part of the daily routine. The Nazis took over state governments and ousted the officials of the chief towns. Frightened by threats of violence, the Reichstag proceeded to pass an act which gave Hitler absolute authority during a period of four years. This act the Nazis immediately used in order to destroy all political opposition. The conservatives were the last to give way. But in a "blood purge," in 1934, aimed primarily at them, Hitler executed more than 1,000 persons without trial. President von Hindenburg and the Reichswehr did not even attempt to hold the Nazis responsible for this act of mass murder. Resistance to Hitler inside Germany broke down almost completely.

On June 6, 1936, the German police were brought under the command of Heinrich Himmler. This action placed the *Gestapo*, or secret political police, in the driver's seat. During the same year Hitler also made two important decisions having the gravest effect upon international order. First, he denounced the Pact of Locarno which had laid down the western boundaries of Germany; and he marched troops into the Rhineland, a zone around the Rhine River where armies were forbidden according to the Versailles Treaty. Second, the Rome-Berlin Axis was formed, an alliance between Italy and Germany. Japan joined the Axis a month later. The world looked on, and did nothing to prevent these acts.

As early as 1935 Hitler had declared that Germany would no longer agree to remain disarmed, and he had ordered conscription; he had arranged a secret naval treaty with Great Britain, and he had managed to secure foreign credits for the purchase of nickel, copper and other raw materials needed by the armament industry. Even more notable is the fact that in 1937 he was able to erect a strong wall of defense along Germany's western border. This he thought would make it impossible for France to attack. He also secured, in 1937, industrial aid from abroad.

Intoxicated by these successes, and in complete control of the government, Hitler became unrestrained. The younger generation was ardently on his side. Boys and girls, young men and young women, accepted the nazi doctrines without question, and almost worshiped Hitler as their Führer, their leader. He had the country with him. He had soldiers trained in the most modern forms of warfare. He had the weapons.

By the spring of 1938 he was ready to move. Austria was the first victim. Hitler demanded *Anschluss*, that is, the joining of Austria with Germany. There were some Nazis in Austria who wanted *Anschluss*. The government in Vienna called for a plebiscite (general vote) on the question, but before the vote was taken, an armed German force started marching. The Vienna government gave in and Austria as a country no longer existed; it became but a province of Germany. Vienna and other Austrian cities were "purged" of the opposition. During two days, more than 50,000 persons were herded into concentration camps where many of them died after brutal abuse. The banks of the country were looted, and Hitler acquired substantial amounts of gold and foreign exchange.

CZECHOSLOVAKIA IS "SOFTENED UP" FOR CONQUEST

Czechoslovakia was now sorely threatened, and a propaganda campaign against that unhappy country was soon in full swing. It was alleged that German residents there were being mistreated. The British Government dispatched a commission to study the question. Since France was pledged to come to its assistance, the Czechoslovakian Government adopted a firm attitude, and during the summer of 1938 a general European war seemed near.

THE VAINGLORIOUS BOAST IS STILLED

Acme photo by Charles Haacker

The destruction and ruin of war came to the very heart of Berlin, the once gay Potsdamer Platz.

Official U. S. Navy photograph

The Europa, which rang with the laughter of transatlantic travelers in happier days, idled in the docks at Bremerhaven all during the war. The Germans did not dare to send their famed luxury ship to sea.

At the height of the crisis, Neville Chamberlain, British prime minister, decided to visit Hitler at Godesberg, Germany. This conference was followed by a meeting of the four major powers in western Europe at Munich, September 29—Great Britain, France, Germany and Italy. Hitler emerged the victor. Czechoslovakia was carved up, and Germany secured a goodly slice. Although he had promised to respect the borders of the purely Czech regions of the little republic, few doubted that he would soon enter Prague. This he did during March, 1939, and thus gained control of one of Europe's most important armament works, the Skoda plant, together with stores of raw material and fleets of tanks amassed by the Czech army.

The German victories had been truly stupendous, but Hitler wanted more. He turned his attention toward Poland. First he started a propaganda campaign, accusing Poland of atrocities committed on the persons of German citizens. But now the British, dismayed by the mounting threat of Hitlerism, and appalled by the evidence of brutality reported from inside Germany, decided to intervene. The British Government promised to give aid to Poland if the weaker country should be attacked.

Nevertheless, hoping that war might yet be avoided, Great Britain tried in vain to arrange a peaceful settlement of the most urgent dispute between Poland and Germany —the matter of a strip of territory, the Polish Corridor, which separated East Prussia from the rest of Germany. President Roosevelt urged Hitler to solve the controversity without force. A final peace move was made by the Vatican. All efforts of the peacemakers were in vain.

On August 23, 1939, a non-aggression pact was signed by Germany and the Soviet Union. A week later, on September 1, the Germany army invaded Poland without a declaration of war. The armed forces of

Field Marshal Keitel surrenders the German Army.

Both pictures, Signal Corps photos

Conference of victors—American, British and Russian—in Potsdam, in 1945, after the fall of Germany.

Associated Press photo

The end of an evil dream of conquest—nazi leaders on trial before an international court, in Nuremberg.

Great Britain and France were mobilized for action on the same day. Thus began the greatest and most costly struggle in the annals of humanity. Of the complete responsibility of Hitler and his henchmen for this tragedy there can be no doubt. They are the authors of a catastrophe which will stagger the imagination for centuries to come.

We have, in these pages, told you the important events of Germany's history. You have seen, in the ancient days, the German tribes at war with one another, and with the civilized world of Rome, and with neighboring tribes to the north and east. You have watched civilization move northward from Italy and France, and the German tribal areas becoming states, with growing wealth and learning and a deepening religious devotion. You have seen how the states aligned themselves under the banner of the Holy Roman Empire—not really a Roman, but a German, empire. As the centuries passed the states disagreed and fell apart again, and in time were gobbled up, one by one, by Napoleon. When Napoleon's sun had set, one of the German states, Prussia, began to shove itself forward. Its leaders lived, thought and planned as military men; and as victorious military men they brought the states together once more into a strong empire. It became an empire striving for greater military glory; it fought and lost a world war, 1914 to 1918, and still was not convinced that the peaceful way is the better way of life for a nation. So it brought on a second world war, 1939 to 1945, and lost that one, too.

Great areas of Germany were completely destroyed. Her cities lay in ruins and her people suffered unspeakably, as they had made others suffer. She had no central government, no great leaders, and almost no hope for the future. The age-old story of Germany seems to be the tragedy of a nation that again and again destroys itself by its greed for power.

Yet nations must learn to exist together on this earth. A sober, decent way of life must be worked out for the German people, and for all the world, so that dreams of conquest may cease to plunge the whole world into the horrors of war.

By George N. Shuster.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 4325.

Official U. S. Navy photo

Tightening the face plate on a diver's helmet just before he descends. Sailors at the right will "pay out" the air pipe.

DOWN *in the* DEEP, DEEP SEA

In the caverns deep of the ocean cold
The diver is seeking a treasure of gold

THE bottom of the sea is rich in a harvest of sunken vessels and cargoes. How can a diver seek this treasure? It is because he wears a sort of armor which keeps out the water and brings him air from above. By the help of this armor he can also do much valuable work in constructing and repairing foundations under water.

The diver's suit of rubber or metal covers his body from feet to neck. The sleeves end in water-tight cuffs at the wrist, so his hands are free. He puts on a heavy helmet made of tinned copper which fastens to the neck of his suit. In this headpiece are windows of half-inch glass secured in brass frames, and in addition to these there may be a window in the top of the helmet. There is a valve attached to a pipe through which comes the air pumped from above. This valve is what is called a non-return and is very important, for if the air pipe is broken, the valve closes and gives the diver a short time to realize his danger and act for safety. A second valve in the helmet lets out the air which has been breathed. Electric lamps and telephones are provided so that the diver has the means of seeing around him and he can communicate with those above him regarding his operations and they can send messages to him. In order that he may sink, feet first, into the water he wears lead in his boots and lead weights tied around his waist.

One invention is called a ground block. This is a stand, or anchor, with steps cut in the side upon which he may ride down and up in comfort. Its purpose is to relieve the diver of the weight of his cable, which is attached to the block. When he reaches the bottom he can set up his anchor and fix his cable on a pulley so that he then has to

These pictures show the evolution of the diving suit. The suit on the left of the top row was made about 1500; it could be used for diving only in very shallow water. To the right of this suit is one made in 1798. The next was invented in 1819. From it has been evolved the diving suit of today, as seen in the center. The suit on the right of the middle row is self-contained. The suits below are for deep-sea work.

STRANGE SIGHTS ARE SEEN IN THE SEA

Pinney from Acme

Dr. William Beebe, noted scientist, poses with Otis Barton (left), the inventor of the bathysphere. This hollow, iron shell can withstand enormous pressures. Men are able to observe marine life through its heavy glass windows.

One method of raising a sunken vessel is to send divers to patch up the holes. Then the water is pumped out.

This diver, photographed under water with air bubbles streaming from his helmet, is inspecting an old wreck.

drag about with him only the part between himself and the reel.

The deepest that a man has ever been known to dive is 420 feet. Actually, men seldom go down more than one hundred feet. The deeper down, the greater is the pressure which the diver's body must bear. To equalize the pressure inside and outside his body, he must breath air of increasing pressure. A man who goes down sixty feet has to breath air at twice the pressure of the ordinary atmosphere. The result is that his blood and tissues become saturated with nitrogen. This in itself does no harm; but as the diver comes up there is steadily decreasing pressure outside the body. The tissues and blood try very hard to get rid of the excess gas, so as to keep the pressure evenly balanced. But if the operation is too quick, bubbles may form in the man's veins. The joints of the knees and elbows are especially susceptible. This condition, known as "the bends," may cause paralysis or even death. To guard against this a diver must take a long time in coming up out of the water, resting at different depths so that the bubbles may disappear before they become too big. A timetable for divers has been made so that they may know how to descend, work and come up again with the greatest safety.

The pressure on a man's body can be increased in this chamber, just as in an actual dive. It is used to test new divers.

In recent years experiments have proved that breathing a supply of oxygen and helium (instead of ordinary air, which is largely oxygen and nitrogen) will reduce the resting time on the way to the surface. This is true because of the fact that helium gas is less soluble in the watery parts of the body than nitrogen, and therefore less of it is absorbed. Helium will also escape from the lungs about three times as fast as nitrogen. The use of helium, then, permits a diver to rise from the ocean's depths more rapidly than he would if using ordinary air.

An effect similar to that felt in diving occurs when people go up to great heights in airplanes. The rapidly decreasing pressure upon the body must be counter-balanced; and also the increasing pressure as the plane comes down.

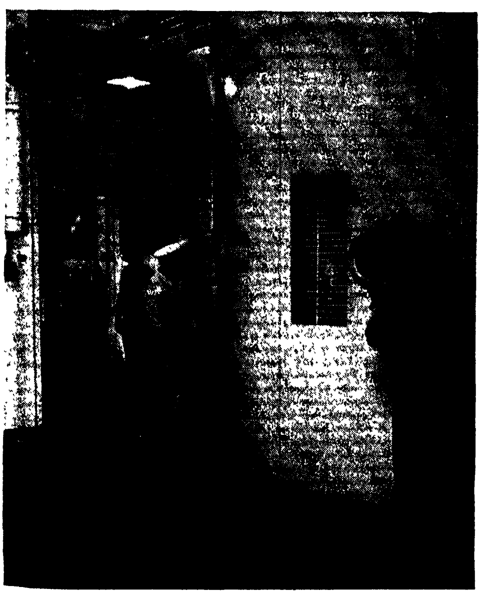
The diver often has to do heavy work in attaching cables and otherwise helping to recover wrecks and cargoes. He needs hammers, drills, scrapers and cutters. He needs some way of carrying these to the bottom of the sea and of storing them while he is at work. For this a clever inventor has made a submarine air-room, which can be lowered to the sea bottom from the surface, with which it is connected by air hose. It carries telephone cables and serves as the diver's base of operations, instead of the ship. There he can keep his tools, and there he can retreat for safety from rapid currents or if anything goes wrong with his suit or connections. His own line runs horizontally from it, instead of vertically from the ship above, and is thus less liable to accident from currents.

Many ships with valuable cargoes were sunk during both world wars, providing work for divers seeking to recover the treasure. In January, 1917, the White Star steamer Laurentic was torpedoed and went down off Malin Head, Ireland. She was carrying $25,000,000 in gold. Divers recovered almost all of this, though the salvage job took seven years, for the huge liner had

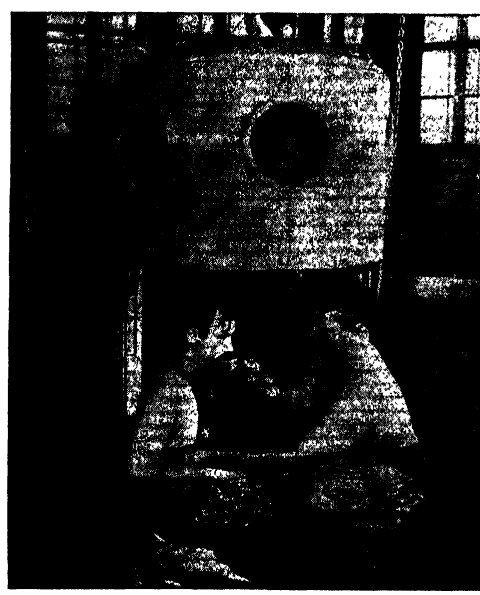
AT THE SCHOOL FOR DIVERS

All pictures on pages 4188-91, official U. S. Navy photos

This is a classroom scene at the United States Navy's school for divers at Washington, D. C. Only volunteers are accepted for this type training. Before candidates are assigned they are given a careful physical examination to find out if they are suited for diving work; only those under thirty years of age are eligible. At the school they are taught the theory and practice of diving; they are also taught how to use the tools that are necessary in diving operations.



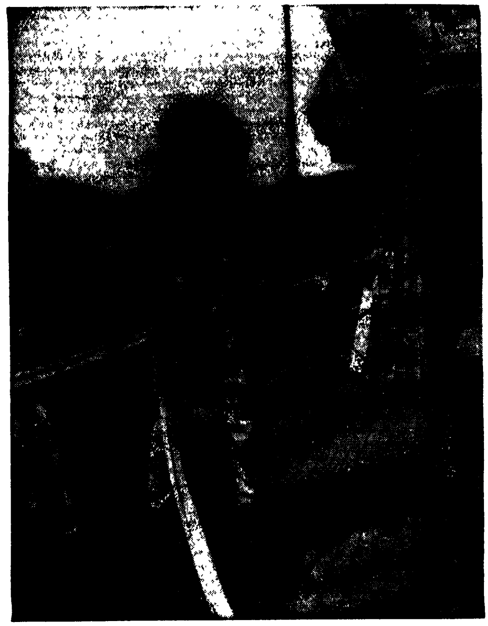
The training tank at the Washington diving school; here recruits make their first dives. A diver-in-training has just been lowered into the tank. Note the observation window in the foreground; an observer can watch the diver through this window.



Practicing escaping from a disabled submarine. The recruit, with respirator (breathing device) attached, enters the diving bell, which is lowered to a depth of twelve feet. The recruit then makes his way out of the diving bell and up to the surface.

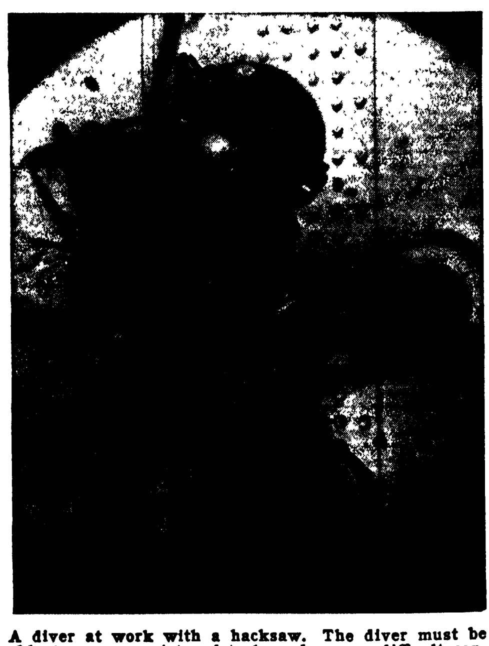
THE DIVER'S CURIOUS OUTFIT

Rubber suits and diving helmets. The diver's outfit must be water-tight; it must also be able to withstand the tremendous pressure of the water. The latest style diving suits are insulated with fiberglas and heated with electricity for greater comfort.



The lead weights about this diver's waist enable him to sink rapidly; the heavy lead-soled shoes enable him to keep his balance under water. The sleeves of his suit end in water-tight cuffs at the wrist, and his hands are covered with heavy gloves.

A diver goes over the side to inspect the hull of a ship that is tied up in port. He will not have to descend very far. The deepest that a man has been known to dive is 420 feet, but actually men seldom go down more than 100 feet.



A diver at work with a hacksaw. The diver must be able to use a variety of tools under very difficult conditions. He is usually provided with an electric lamp and a telephone for talking to those on the surface. Experienced divers are always in demand.

gone down in 120 feet of water. The enormous pressure twisted the ship's steel plates into scrap. Divers worked three years to recover much of the $5,000,000 treasure that went down with the S.S. Egypt off Brest, France.

Divers are carried by every man-of-war. If anything happens to the ship below the water line, the men put on their dress, go down with tools and repair the damage. To one kind of diving suit is attached a cylinder of compressed air, and with this the diver is not encumbered with air hose and can not be suffocated by a kink in it caused by a current. To make his supply hold out for a long period of time he has an air-purification circuit in which a substance called caustic soda or potash absorbs the poisonous carbon dioxide from the man's breath.

Another development in this field is the "bathysphere" (literally, "depth ball"). This is a sturdy hollow iron sphere fitted with thick quartz windows. Dr. William Beebe and Otis Barton have descended inside the sphere more than 3,000 feet into the sea off Bermuda, deeper than men have ever gone before. However, the bathysphere is meant purely for the study of marine life and can not really be compared with diving suits.

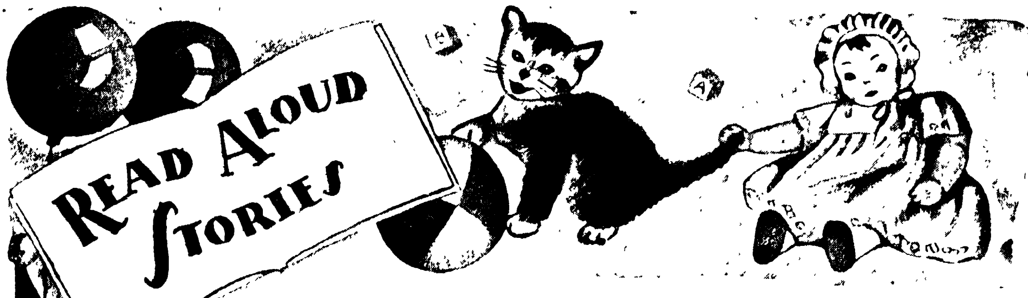
In salvaging the Egypt, something similar was used. A sealed observation shell was sunk 400 feet, and the man inside directed by telephone the movement of the grappling devices let down from above.

Divers have many times helped to locate sunken submarines which have gone down after an accident. After finding the sunken boat, divers can communicate with the imprisoned men by telephone or other means. Divers can often help to direct the raising of the ship, and even to aid men to escape. Nowadays by a device called the diving bell, men climb out of a submarine that has gone down.

The air that the diver breathes under water is supplied by members of the surface crew manning the air pump. Some diving suits have cylinders of compressed air for the diver to breathe. This does away with pump and hose.

The most unusual work done by a diver was probably that carried out in connection with Winchester Cathedral in England. This ancient cathedral had been built on beech piles sunk in a water-logged peat bog. These piles rotted, in time, and had to be replaced with cement. To pump the water out would have meant the collapse of the walls, so a diver was employed to do the work in the water.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4293.



THE STORY OF LI'L' HANNIBAL

By Carolyn Sherwin Bailey

Courtesy, The Platt and Munk Co., Inc., Publishers

Once on a time, 'way down South, there lived a little boy named Hannibal, Li'l' Hannibal. He lived along with his gran'mammy and his gran'daddy in a li'l' one-story log cabin that was set right down in a cotton field. Well, from morning until night, Li'l' Hannibal's gran'mammy kept him toting things. As soon as he woke up in the morning it was:

"Oh, Li'l' Hannibal, fetch a pine knot and light the kitchen fire."

"Oh, Li'l' Hannibal, fetch the teakettle to the well and get some water for the tea."

"Oh, Li'l' Hannibal, mix a li'l' hoecake for your gran'daddy's brea'fus'."

"Oh, Li'l' Hannibal, take the bunch of turkeys' feathers and dust the ashes off the hearth."

And from morning until night, Li'l' Hannibal's gran'daddy kept him toting things, too.

"Oh, Li'l' Hannibal," his gran'daddy would say, "fetch the corn and feed the turkeys."

"Oh, Li'l' Hannibal, take your li'l' ax and chop some lightwood for gran'mammy's fire."

"Oh, Li'l' Hannibal, run 'round to the store and buy a bag of flour."

"Oh, Li'l' Hannibal, fetch your basket and pick a li'l' cotton off the edge of the field."

So they kept poor little Hannibal toting 'most all day long, and he had only four or five hours to play.

Well, one morning when Li'l' Hannibal woke up, he made up

his mind to something. Before they could ask him to light the kitchen fire, or fill the teakettle, or mix the hoecake, or dust the hearth, or feed the turkeys, or chop any wood, or go to the store, or pick any cotton, he had made up his mind that he was not going to tote for his gran'mammy and his gran'daddy any longer. He was going to run away!

So Li'l' Hannibal got out of bed very quietly. He put on his li'l' trousers, and his li'l' shirt, and his li'l' suspenders, and his li'l' shoes—he never wore stockings. He pulled his li'l' straw hat down tight over his ears, and then Li'l' Hannibal ran away!

He went down the road past all the cabins. He went under the fence and across the cotton fields. He went through the pine grove past the schoolhouse, stooping down low—so the schoolmistress couldn't see him — and then he went 'way, 'way off into the country.

When he was a long way from town, Li'l' Hannibal met a possum loping along by the edge of the road, and the possum stopped and looked at Li'l' Hannibal.

"How do? Where you goin', Li'l' Hannibal?" asked the possum.

Li'l' Hannibal sat down by the side of the road and took off his straw hat to fan himself, for he felt quite warm, and he said,

"I done run away, Br'er Possum, my gran'-mammy and my gran'daddy kept me totin', totin' for them all the time. I don't like to work, Br'er Possum."

"Po' Li'l' Hannibal!" said the possum, sitting up and scratching himself. "Any special place you bound for?"

"I don't reckon so," said Li'l' Hannibal, for he was getting tired, and he had come away without any breakfast.

"You come along with me, Li'l' Hannibal," said the possum; "I reckon I kin take you somewhere."

So the possum and Li'l' Hannibal went along together, the possum loping along by the side of the road and Li'l' Hannibal going very slowly in the middle of the road, for his shoes were full of sand and it hurt his toes.

They went on and on until they came, all at once, to a sort of open space in the woods and then they stopped. There was a big company there — Br'er Rabbit and Br'er Partridge, and Br'er Jay Bird and Br'er Robin, and Ol' Miss Guinea Hen.

"Here's po' Li'l' Hannibal come to see you," said the possum. "Li'l' Hannibal done run away from his gran'mammy and gran'-daddy."

Li'l' Hannibal hung his head as if he was ashamed, but nobody noticed him. They were all as busy as they could be, and so he just sat down on a pine stump and watched them.

Each one had his own special work and he was keeping at it right smart. Br'er Robin was gathering all the holly berries from the south side of the holly tree and singing as he worked:

"Cheer up, cheer-u-up!"

Br'er Partridge was building a new house down low in the bushes. As he hurried back and forth with twigs, he would stop and drum a little, he felt so happy to be busy.

Br'er Jay Bird was taking corn down below. You know that is what Br'er Jay Bird does all the time. He takes one kernel of corn in his bill to the people down below and then comes back for another. It is a very long trip to take with one kernel of corn, but Br'er Jay Bird doesn't seem to mind how hard he works.

Ol' Miss Guinea Hen was almost the busiest of the whole company, for she was laying eggs. As soon as ever she laid one she would get up on a low branch and screech, "Catch it! Catch it! Catch it!" like to deafen everybody.

But Li'l' Hannibal was most interested to

see what Br'er Rabbit was doing. Br'er Rabbit had on a li'l' apron, and he kept bringing things in his market basket. Then he cooked the things over a fire back in the bushes, and when it got to be late in the afternoon, he spread a tablecloth on a big stump and then he pounded on his stewpan with his soup ladle. "Supper's ready," said Br'er Rabbit.

Then Br'er Robin, and Br'er Partridge, and Br'er Jay Bird, and Br'er Possum, and Ol' Miss Guinea Hen all scrambled to their places at the table and Li'l Hannibal tried to find a place to sit, but there wasn't any.

"Po' Li'l' Hannibal," said Br'er Rabbit as he poured the soup. "Doesn't like work! Doesn't like to tote for his gran'mammy. Can't have no supper!"

"Catch him! Catch him!" said Ol' Miss Guinea Hen, but no one did it. They were all too busy eating.

They had a grand supper. There was breakfast strip, and roast turkey, and fried chicken, and mutton and rice, and hominy and sweet potatoes, and peas and beans, and baked apples, and cabbage, and hoecake, and hot biscuits, and corn muffins, and butter cakes and waffles and maple syrup.

When they were through eating, it was dark, and they all went home, and they left Li'l' Hannibal all by himself.

Well, after a while it began to get darker. Br'er Mocking Bird came out, and he looked at Li'l' Hannibal and then he began to scream, just like Ol' Miss Guinea Hen,

"Catch him! Catch him! Catch him!"

Br'er Screech Owl looked down from a tree and he said very hoarsely:

"Who! Who! Who-oo!"

Then all the frogs began to say, loud and shrill, "Li'l' Hannibal! Li'l' Hannibal!" like they thought he was deaf.

So Li'l' Hannibal got up from his pine stump and he said, "I reckon I better go home to my gran'mammy."

Well, Li'l' Hannibal started for home slowly, because his feet hurt and he was hungry. When he came to the pine grove by the schoolhouse the shadows came out from behind the trees and followed him, and that was much worse than seeing the schoolmistress. But Li'l' Hannibal got away from them all right. He crawled under the fence and ran across the cotton field, and there in the door of the cabin was his gran'daddy with a lantern. His gran'daddy had been out looking for Li'l' Hannibal.

"Why, Li'l' Hannibal, where you been all day?" asked his gran'daddy.

"Oh, Li'l' Han'," said his gran'mammy, "here's your corn

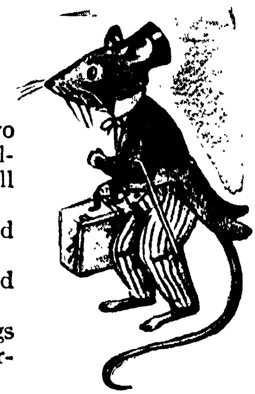
mush. I kep' it warm on the hearth, but afore you eat your supper, Li'l' Han, jus' take your li'l' basket and run 'round to the chicken house for a couple of eggs."

So Li'l' Hannibal took his li'l' basket, and he started for those eggs singing all the way. You see, he reckoned he was mighty glad to be at home, and toting again.

THE TOWN MOUSE and THE COUNTRY MOUSE

A FABLE OF AESOP THE SLAVE

This version is by Joseph Jacobs



ONCE upon a time, a Town Mouse went on a visit to his cousin in the country. He was rough and ready, this country cousin, but he loved his town friend and made him heartily welcome. Beans and bacon, cheese and bread, were all he had to offer, but he offered them freely.

The Town Mouse turned up his long nose at this country fare, and said: "I can not understand, Cousin, how you can put up with such poor food as this; but of course you can not expect anything better in the country. Come with me and I will show you how to live. When you have been in town a week you will wonder how you ever stood a country life."

No sooner said than done; the two mice set off for the town and arrived at the Town Mouse's residence late at night.

"You will want some refreshment after our long journey," said the polite Town Mouse, and took his friend into the grand dining-room. There they found the remains of a fine feast, and soon the two mice were eating up jellies and cakes and all that was nice.

Suddenly they heard growling and barking.

"What is that?" said the Country Mouse.

"It is only the dogs of the house," answered the other.

"Only!" said the Country Mouse. "I do not like that music at my dinner."

They set to eating again, but all on a sudden the Town Mouse cried: "Run for your life!" and he sprang down from the table and ran away. Just before the Country Mouse followed, he looked up and saw two fierce yellow eyes glaring at them.

"What was that?" said the Country Mouse when they were safe outside.

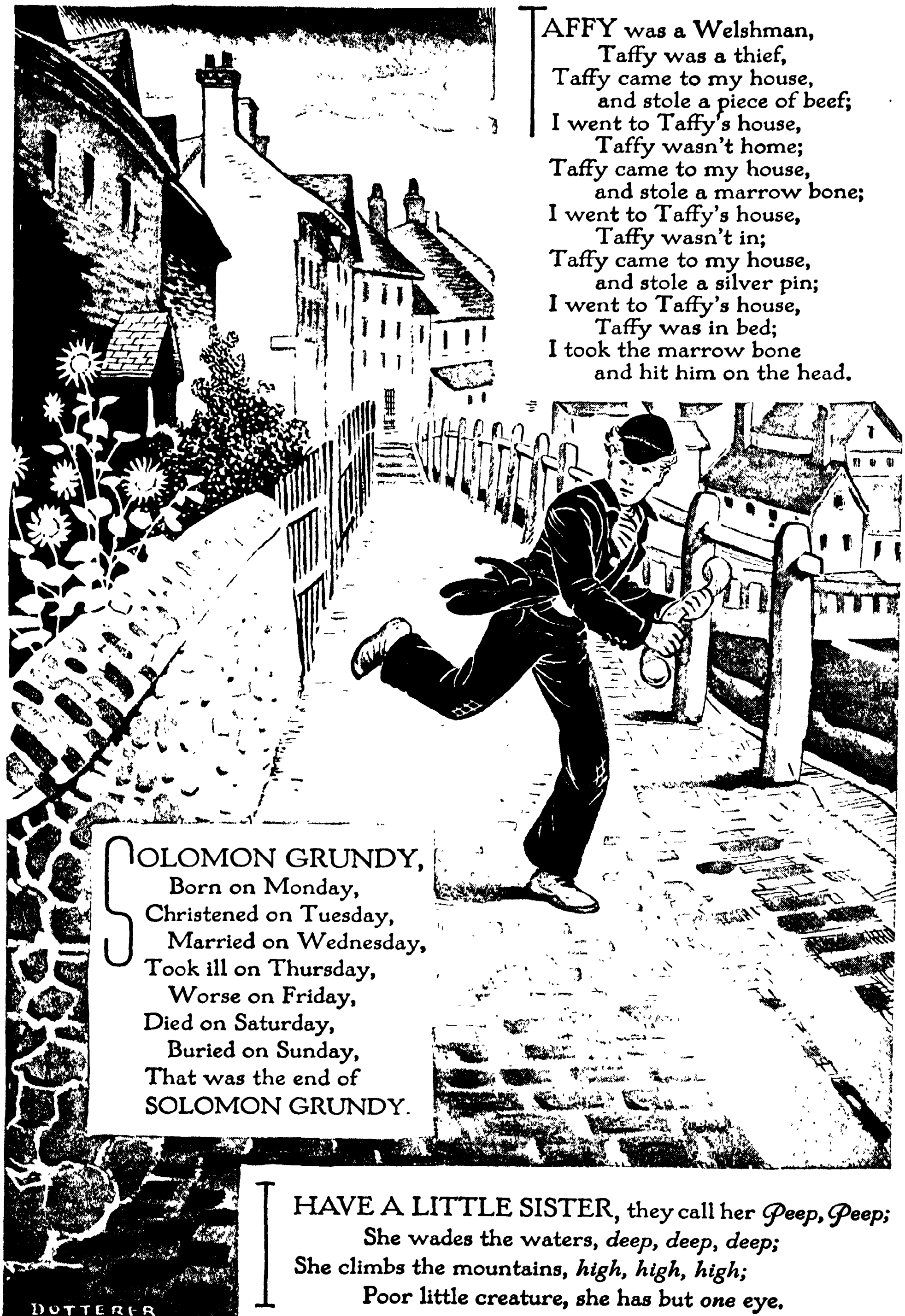
"It was the cat," answered the other.

"Good-bye, Cousin," said the Country Mouse.

"What! Going so soon?" said the other.

"Yes," he replied. "*Better beans and bacon in peace than cakes and ale in fear.*

THE NEXT READ ALOUD STORIES ARE ON PAGE 4557.



TAFFY was a Welshman,
Taffy was a thief,
Taffy came to my house,
and stole a piece of beef;
I went to Taffy's house,
Taffy wasn't home;
Taffy came to my house,
and stole a marrow bone;
I went to Taffy's house,
Taffy wasn't in;
Taffy came to my house,
and stole a silver pin;
I went to Taffy's house,
Taffy was in bed;
I took the marrow bone
and hit him on the head.

SOLOMON GRUNDY,
Born on Monday,
Christened on Tuesday,
Married on Wednesday,
Took ill on Thursday,
Worse on Friday,
Died on Saturday,
Buried on Sunday,
That was the end of
SOLOMON GRUNDY.

I HAVE A LITTLE SISTER, they call her *Peep, Peep;*
She wades the waters, *deep, deep, deep;*
She climbs the mountains, *high, high, high;*
Poor little creature, she has but *one* eye.

PAT-A-CAKE, pat-a-cake, baker's man.
Roll it and roll it as fast as you can,
Pat it and prick it and mark it with T,
Put it in the oven for Tommy and me.

ONCE I saw a little bird
Come *hop, hop, hop;*
So I cried, "Little bird,
Will you *stop, stop, stop?"*
I was going to the window
To say, *"How do you do?"*
But he shook his little tail,
And *far away he flew.*

ONE little, two little, three little Injuns,
Four little, five little, six little Injuns,
Seven little, eight little, nine little Injuns,
Ten little Injun boys.
Ten little, nine little, eight little Injuns,
Seven little, six little, five little Injuns,
Four little, three little, two little Injuns,
One little Injun boy.

I Saw a Ship

I saw a ship a-sailing
    A-sailing on the sea;
And oh, it was all laden
    With pretty things for thee!

There were comfits in the cabin,
    And apples in the hold;
The sails were made of silk,
    And the masts were made of gold.

The four-and-twenty sailors
    That stood between the decks,
Were four-and-twenty white mice,
    With chains about their necks.

The captain was a duck,
    With a packet on his back,
And when the ship began to move,
    The captain said, "Quack, quack!"

Babyland

By George Cooper

"How many miles to Babyland?"
    "Any one can tell!
    Up one flight; to the right.
    Please to ring the bell."

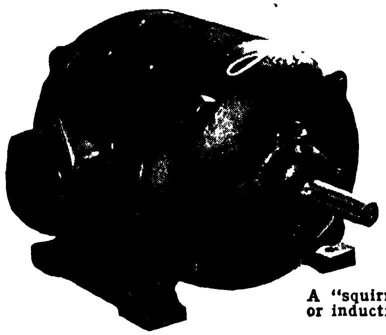
"What can you see in Babyland?"
    "Little folks in white —
    Downy heads, cradle-beds,
    Faces pure and bright."

"What do they do in Babyland?"
    "Dream and wake, and play,
    Laugh and crow, shout and grow.
    Jolly times have they!"

"What do they say in Babyland?"
    "Why, the oddest things!
    Might as well try to tell
    What a birdie sings!"

"Who is the Queen of Babyland?"
    "Mother, kind and sweet;
    And her love, born above,
    Guides the little feet."

ELECTRIC MOTORS and GENERATORS



A "squirrel cage," or induction motor.

YOU may read elsewhere in the Department of Science what electricity is, and how it is measured. Now we can find out in more detail how electricity is "generated" —in machines which are properly called *generators*—and how electricity can be used to do work—by means of *motors.*

First we will look at the way generators work. You have, of course, seen and used batteries. They might be called chemical generators of electricity. Dry-cell or storage batteries are very often used to produce electricity, particularly when the source of electricity has to be portable, as in your flashlight or in your father's car.

But batteries have great disadvantages. They run down, and so stop delivering current after some use. Then one has to buy new ones, or re-charge them from another source of electricity. Also, batteries are quite expensive as current suppliers, and they are easily damaged if large currents are drawn from them. Lastly, there is another disadvantage to the use of batteries: sometimes we need alternating electric current (that is, current which flows back and forth through a wire) instead of direct current. A battery, however, can send out only direct current (that is, electricity which flows constantly in the same direction through a wire).

The kind of generators which we shall now discuss manage to overcome most of these objections. Instead of using chemical energy to produce electrical energy (which is what batteries do), these generators use mechanical energy such as that developed by steam engines, or gas engines, or water-wheels. The electric current so developed, whether direct or alternating, can be sent long distances, through wires, to our houses or factories. And what is more, the cost of this electricity is usually small. A penny would probably pay for about five hours of light from your reading lamp!

How do such generators work? All generators (and motors, too) make use of a few simple laws of physics which were discovered about one hundred years ago. By a "law of physics" we simply mean the rules which seem to govern the progress of an experiment every time it is performed. For instance, if you hold a stone in your hand and drop it to the ground it will take the same length of time to fall, no matter how often you try it. Therefore, we could call the description of the stone's fall a law of physics. There are a great many such laws; the best ones are those that describe a lot of different experiments in a simple manner. The laws that describe the behavior of motors and generators are, in this sense, among the best.

It was a Danish physicist, Hans Christian Oersted, of Copenhagen, who in 1819 first discovered that a magnet needle will be deflected from its normal position if brought near a wire which is carrying a current. The stronger the current, the more powerful the effect. It was already well known that magnet needles could be deflected by bringing them close to other magnets. Therefore, it was natural to explain Oersted's interesting discovery by saying that his magnet needle was deflected by a nearby electric current because *an electric current sets up a magnetic field around itself.* It is this magnetic force which acts on a magnet needle. (The words in italics above state an important law of physics.)

However, by making experiments it was quickly found that the magnetic force created by a current differs in an amazing way from the forces of an ordinary bar magnet or horseshoe magnet. As you know, the forces of an ordinary, permanent steel magnet go from one end of the magnet to the other in lines, from the north pole to the south pole. (See Figure 1.)

A little magnet needle, put between the poles of the big permanent magnet, would

line up along such a line of force, as shown.

The lines of magnetic force that appear around a straight, current-carrying wire, however, make circles around the wire. (See Figure 2.) A magnet needle brought near the wire will line itself up, as shown, along a small piece of such a circle. If the current flowed steadily in the opposite direction through the wire, the magnet needle would also point in the opposite direction.

This magnetic effect of a current goes without much change right through any material that does not itself become magnetic.

As soon as scientists had found out this much, they tried to see what the magnetic field would be around a coil made out of one straight wire. They discovered that if current flowed through the coil as shown in Figure 3, the magnetic lines of force around the coil behaved as though a bar magnet were present instead of the coil! (Figure 4.)

Now it happens very often in science that if one effect occurs, the reverse effect can also be produced. In our example of the current-carrying coil we might therefore reason: if the magnetic field created by a steady current is like that of a bar magnet, should not a steady current be induced in a coil of wire by simply putting a bar magnet into the hollow space along the middle of that coil? Going further, instead of using

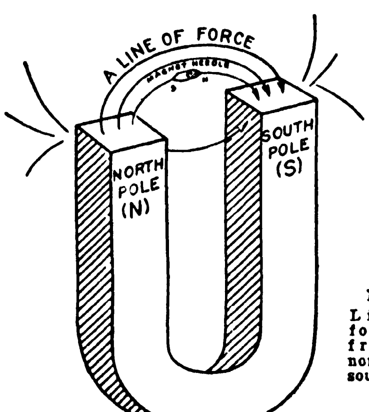
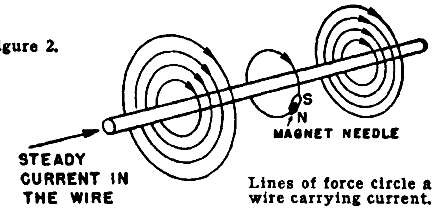


Figure 1. Lines of force run from the north to the south pole.

the bar magnet inside the coil, let us wind another coil into or around the original coil. Let that other, or primary coil, carry a current. The original, or secondary, coil should not be connected to the primary or to any source of current. Will the magnetic field created by a current sent through the primary induce a current in the secondary?

For a long time this question puzzled one of the great men of science, Michael Faraday. No matter how he tried, every experiment failed to show the expected induced current. And then, one day, he saw that just at the moment of switching on or switching off the primary current, a brief trickle of electricity was actually induced in the secondary coil. In other words, though a steady magnetic field around a coil does not of itself persuade

Figure 2.



Lines of force circle a wire carrying current.

a constant electric current to flow in another coil, a suddenly *changing* magnetic field will create the induced current! Such a changing field is present, of course, when current is first switched on in the primary. The magnetism around the coil has to be built up. Similarly, when the current in the primary is switched off, the magnetic field around the the coil dies down.

Instead of using a primary coil, we can produce the changing magnetic field by simply moving a permanent bar magnet close to the coil that carries no current, and then withdrawing it again quickly. (Figure 5.) As the magnet approaches the coil, current is induced in the loops of wire in one direction since the magnetic field gets stronger and stronger. By withdrawing the magnet quickly, the field gets weaker and weaker, and now current in the opposite direction is induced in the wires. (If we simply held the magnet steady and next to the coil of wire, no current would flow.) Here then is our second important law on which all generators and motors depend: *A current is induced in a wire if that wire is immersed in a changing magnetic field.* It does not matter whether this changing magnetic field is created by changing the current in an auxiliary coil near by, or by moving a permanent magnet, or even by moving an auxiliary coil that carries a steady current. The idea is to vary the strength of the magnetism.

We can even predict in which direction the induced current will flow, though you may have to read the following sentences slowly and several times to understand them well.

The induced current flows in such a direc-

tion that: when it sets up a magnetic field of its own (as it does, by our first law) this field tries to oppose the change in magnetism

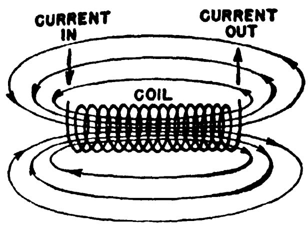
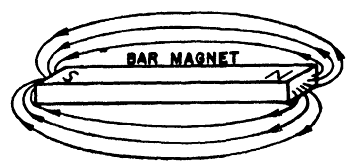


Figure 3. Current in a coil produces lines of force like these.

which induced the current in the first place. Thus, if increasing magnetism induces a current, that current will flow in such a direc-

Figure 4. The coil in Figure 3 acts like this bar magnet.



tion that its own field tries to decrease the original magnetism. This ungrateful behavior of induced currents is the essence of our third law, called Lenz's Law, after its discoverer.

Now we come to a very important experiment. Imagine we have a long, straight wire, not connected to a source of electricity. It is attached, however, to a current meter. There is no current flowing through the wire, and the meter reads zero.

Up till now in our tests we have kept the wire still; we have either moved the bar magnet, changed the current in a second coil near by, or moved an auxiliary coil carrying a steady current. Instead of one of these, suppose we now try moving the wire. Move it through the gap between the north and south poles of a stationary magnet. The meter will show an induced current in the wire, just as in the first three cases. Figure 6 shows you this experiment. You can see at once that we could generate electricity if we mounted the wire on some kind of wheel

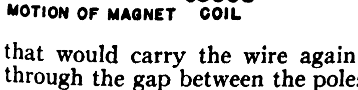


Figure 5. Moving the magnet induces a current.

that would carry the wire again and again through the gap between the poles of a magnet, just as a Ferris wheel might carry a little car through the space between the ground beneath and a bird hovering in the sky.

The faster we push the wire through the gap, and the more of these lines of magnetic force between the poles that are cut by the wire during each second, the stronger is the momentary current so induced. But now we begin to suspect that it will take quite a large force to move the wire through the magnetic field, for the electricity we so generate can do work for us. Unless it takes at least this much work to move the wire, we would have here a way of getting out energy without putting any into the generator. And we know well that nowhere in nature is it possible to get anything for nothing.

Actually this guess of ours would turn out to be quite right. The mechanical energy needed to move the wire and so to create a current is usually obtained from a steam engine, a gas motor or turbine, or from a water-wheel. On farms, small windmills are often used as driving units for generators. The force that has to be overcome in moving the wire is, of course, the force between the magnetic field of the steady magnets and the magnetism that the induced current creates around itself.

Now we are ready to design a generator that is more efficient than a simple wire moving back and forth through a gap between magnetic poles. For instance, we could make one loop of wire and mount it on a spindle between the poles, as seen in Figure 7. While the left part of the loop passes upward, the right side goes down, and currents flowing in opposite directions are induced

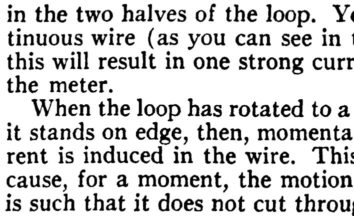


Figure 6. A current is induced by moving the wire through the field of the magnet.

in the two halves of the loop. Yet, in a continuous wire (as you can see in the picture) this will result in one strong current through the meter.

When the loop has rotated to a point where it stands on edge, then, momentarily, no current is induced in the wire. This is true because, for a moment, the motion of the wire is such that it does not cut through any lines of magnetic force; it moves parallel with them. (Figure 8.) And when the loop has rotated into a third position, (Figure 9) where the right and left halves of the loop are now interchanged as compared to the first posi-

tion, then current will flow through our meter in a direction opposite to the first case. As the loop rotates, the meter receives alternating current of a frequency that increases with the speed of rotation.

In practice, more than one loop of wire is used, since in this manner greater currents can be produced. The loops are wound on an iron core to increase the effect of the magnetic field. Such an assembly is called an "armature." Generally there are also more than one pair of magnetic poles. Four pairs, placed symmetrically around the revolving coils, are frequent. The generator is more efficient if the armature is fixed, and if the magnetic poles are rotated instead. In that case the armature is wound on a hollow cylinder or on a ring, with the magnetic poles rotating inside.

If all the loops on the armature are brought out in two separate wires, the generator delivers a large current that alternately rushes in and out of the leads in rhythm with off from here. This is shown for our simple one-loop A.C. generator in Figure 10. You can convince yourself that such a "slip-ring" contact is needed by looking again at Figure 9. Here the connection to the meter would be twisted up badly after a few rotations of the directly connected loop.

We can convert this A.C. generator to a D.C. generator by changing the method of contact. Attach the wires from the loop to rotating split-ring commutators and let the current be drawn from them by contact with stationary brushes. (Figure 11.)

As you can see, the left one of the two metallic brushes always connects the meter with that part of the loop which happens to be nearer the north pole. The right brush makes contact with the other half of the loop. Therefore, even though the loop rotates, the meter is always connected so that the current flows in the same direction.

However, this does not mean that the current is constant; it will be strongest just

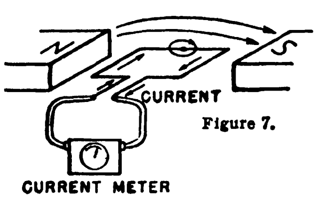


Figure 7.

A simple generator.

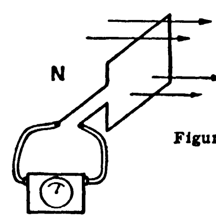


Figure 8.

In this position no current flows.

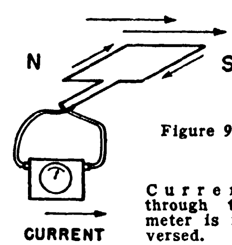


Figure 9.

Current through the meter is reversed.

the rotation. By some tricks of connection between the loops, however, it is possible to get two, three or more different current outlets from one generator. From a "three-phase" generator, for instance, three currents can be obtained which, at any given moment, are a little out of step with one another in their back-and-forth fluctuation. It has turned out that such an arrangement is the most economical, and therefore most alternating-current generators nowadays are such "three-phase alternators."

In a previous story (Current Electricity) you saw the advantages of alternating current over direct current. Sometimes, though, direct current is better, and therefore direct-current (D.C.) generators are still used. They differ from alternating-current (A.C.) generators mostly by a different current-outlet connection.

In all A.C. generators with rotating armatures, the leads from the loops are brought out at one side of the generator, and press against metal rings. The current is drawn as the loop is lying flat (as shown) and then will drop off to nothing at all when the loop is vertical. But still, the current never changes direction of flow; it just flows in squirts. This can be remedied very well by using many loops, many commutators, and many pairs of magnet poles all in one D.C. generator.

Though generators are, in principle, not very complicated, they often require so many additional gadgets to insure safe operation that a "power-house," where electricity is generated, is a very impressive sight. Then also, the machines that move the generators so that they can produce electricity are often very large and complicated, requiring much space and making the scene more striking.

MOTORS AND GENERATORS ARE VERY MUCH ALIKE

Now let us turn to motors. A motor is nothing but a generator in reverse! If the loop in our simple generator is rotated by a steam engine, electricity will be induced in

it because the wire is forced to cut across a magnetic field. And by the rule that we have seen before, the opposite effect also happens. If current is sent through a wire located between two magnet poles, a force pushes on the wire. As we have seen, this force is caused by the interaction of the magnetism belonging to the applied current and that belonging to the poles. A motor is driven by this force. Thus, we see that elec-

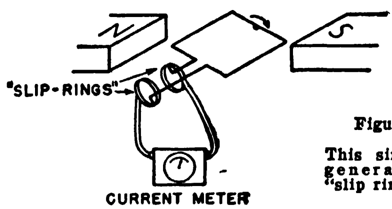


Figure 10.

This simple A.C. generator has "slip rings."

trical energy pumped into the motor is converted to mechanical energy for running electric trains and for thousands of other uses.

SOME OF THE REASONS FOR THE CARE TAKEN IN DESIGNING MOTORS

In principle most generators could become motors by simply supplying electricity to the armature. But in practice there are several small details which may cause a motor to look quite different from a generator. For instance, when a motor is running at full speed, driven by a current supplied from the outside, it also generates some current inside. This is so because the wires of the armature move across the field of the magnet poles. This "inside" current is opposite to the "outside" applied current, and it is the difference between the two which actually makes the motor run. Therefore, if the motor is rotating very rapidly, the net current it uses may actually be quite small. But if a motor should suddenly stop rotating because its load gets too heavy, this internal current no longer is generated; now nothing stops a very large outside current from rushing into the armature, and the coils may be burned out. Therefore, elaborate precautions against such mishaps are taken in the larger and more expensive motors.

On the other hand, some motors will gather speed madly if the load they have to drive becomes too small. Here, too, is a danger that has to be reckoned with. Some other types of motors are so constructed that they will work only at one speed (for example, the synchronous motors used in electric clocks). Because of this they have to be started by hand or by another device until their proper rotating speed is reached.

Though direct-current motors are often preferred for such tasks as driving electric trolley cars, sometimes they are modified so that they can be used either on alternating or direct current. This is the kind that you will find most often in household appliances, because the manufacturers of vacuum cleaners, fans, radios and so on do not want to make two different models of everything, one for houses which use D.C. and the other for houses with A.C.

Lastly, we should mention a kind of A.C. motor that is very frequently chosen because of its simplicity and ruggedness—the induction motor. It works on a principle slightly different from all the others we have discussed so far.

The magnetic field in which the armature swims is now created by three-phase alternating current, which we described on page 4202. This electricity is passed through coils of wire wound around a stationary, hollow cylinder (the "stator"), surrounding the rotating armature (the "rotor"). The stator is so wound that it sets up around the rotor a magnetic field which rotates as the supplied current rises and falls. As this field rotates, it cuts the windings on the armature, and creates a current in them. This induced current in turn, sets up its own magnetic field. As we have seen happen so often, this effect tries to counteract the condition that caused it. The whole armature begins to rotate, trying to follow the field so as to prevent its lines of magnetic force from cutting across the armature wires. In this way we get power from the motor.

Finally, a word about efficiency. In converting electrical energy into mechanical

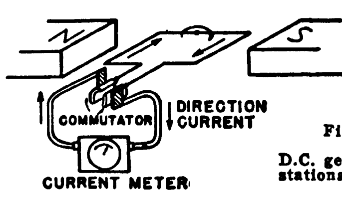


Figure 11.

D.C. generator with stationary brushes.

work, motors show relatively little losses. Only a few per cent of the electrical imput fails to show up as useful energy. Most of what is lost is spent in heating coils and bearings. Few machines are as efficient as motors and generators.

By GERALD J. HOLTON.

THE NEXT STORY OF SCIENCE IS ON PAGE 4289.

British POETRY *in* OUR TIME

POETRY was born under a dancing star. So says the gracious essayist, Robert Lynd, who is perhaps the nearest approach to the gentle Charles Lamb in our twentieth century.

Many are the fields of fancy over which the goddess of Poetry skips and dances in our modern age. It may be in William Allingham's lovely treasure, "Up the airy mountain, Down the rushy glen," or it may be in Francis Thompson's delicate meditation To A SNOWFLAKE, wherein he declares that only the Moulder of all beauty could give us such a fragile filigree fashioned by His "hammer of wind, And His graver of frost."

It is said that poetry in the eighteenth century was "classical." It busied itself with the gods and goddesses of ancient Greece and Rome. It liked the polished phrase, the finished form, smooth perfection and order. The poetry of Alexander Pope is a good example.

It is said that poetry in the nineteenth century came under the heading of the Romantic movement. People grew tired of far-off, classical references, tired of Greek and Roman gods and goddesses, of Zeus and Juno, with their adventures, and their jealousies that disturbed earth and heaven. Besides, said the readers of the nineteenth century, those gods and goddesses never existed. They are far away from the new age of invention, and science and materialism, its coal, its cotton and its factories. Let us get away, men cried, from the fanciful deities of dead empires to living beings that toil and moil on our real green earth. Hence the immortal Robert Burns sang of the cotter, the farmer, sitting by his hearth on a Saturday night, after a week of plowing and planting. Wife and children and home, firelight and supper and rest—around these things Robert Burns wove his charming melodies. And his poems became dear to the hearts of men.

The Romantic movement would bid us go to men, to nature, to the earth, for our inspiration and song. Poets need not worry so much about the style of writing as did those perfection-seekers with their dead classical forms in the eighteenth century. Let us belong to "the old proud pageant of man," as John Masefield would have it.

Byron and Shelley, poets of the first quarter of the nineteenth century, demanded a return to nature: Let us go, they cried, to the rocks, the seas, the lakes, the mountains, the wolds and the sheepfolds: amid the winds and breezes our souls may be healed from the bruises and confusions of city life. Other poets also were to pour out their souls in

praise of Mother Nature. They did not trouble themselves with the question of how many syllables might fit into a line. Lyric poetry, freed from its shackles, soared to glorious heights.

WHICH IS IMPORTANT—WHAT IS SAID IN POETRY, OR HOW IT IS SAID?

This brings us to the eternal question of matter and form in poetry. The Greeks tended to pay more attention to the matter. The Romans tended to pay more attention to the form. It is *what* is said in poetry that counts; so thought some people. It is *how* the thing is said that counts; so thought others. The argument has been going on for hundreds of years. People talk of the "philosophy" of poetry. What does poetry say? What does it mean? What is it for? Could not the same thing be said in prose? Does poetry differ from prose only because of rime? What of blank verse? What of poetry without any rime or word-music?

These are important questions when we consider modern poetry. There are some in our time who hold that "a poem does not have to *mean* but only to *be*." Others insist on a musical mold, and on order and rime, holding that the human heart beats in rhythm and that when it beats in free verse you go to a doctor. G. K. Chesterton challenged our attention with a mixture of nonsense and wit, by saying that nowadays we have poetry without rime, poetry without reason, and soon we may have poetry without words!

Well, we may choose for ourselves what we love. Poetry pirouettes forever under a dancing star, beaming and gleaming in countless lights, flashing across the long years from Homer and his heroes in Hellas to Walt Whitman and the sea-gulls off Long Island. Her twinkling feet beat out music on many shores. The message wherewith she inspires men's minds may reach us in divers ways, just as the ray of light may reach us through the prism in the varying hues of violet, indigo, blue, green, yellow, orange and red. With Shelley we realize that all worlds are interesting, because "Life like a dome of many-colored glass stains the white radiance of eternity."

POETRY TEACHES TRUTH BY MEANS OF BEAUTY

It is difficult to define poetry, just as it is difficult to define some of our daily words —like "love" or "friendship." We know what these things are, but we can not fully convey what we mean by them. It is suggested that poetry is the attempt of the finite to express the infinite, the attempt of the limited to express the unlimited. A great medieval philosopher, Thomas Aquinas, said that poetry should teach us the truth by means of images—beautiful images, no doubt. Take the incident of Francis Thompson's LITTLE JESUS, which is one of the most popular pieces for children in modern poetry. From the image of his own mother Thompson leads us to the Mother of the Child Jesus, Mary, who tucked the Divine Infant into His cradle. Thompson loved his mother dearly; she had so often kissed him good-night and tucked him in for sleep. She died while he was yet young. But he consoles himself by saying that our earth has not changed since the Lord was young. There is always mother-love.

One modern poet, George Russell, hinted that poetry is the giving back of beauty to God. Francis Thompson held that the poet and poetry should make our world more beautiful, for our world is a fallen world, broken and bleeding and disfigured, and the purpose of poetry should be to heal these disfiguring scars.

THREE GREAT SUBJECTS FOR POETRY: RELIGION, NATURE AND LOVE

There are three great and everlasting themes with which poetry may be busy: religion, nature, love. These themes are ever old, ever new. In modern poetry there is the great religious ode of Francis Thompson, THE HOUND OF HEAVEN. Love of nature shines through the work of hundreds of poets, great and small, who have written verse since 1800. Francis Ledwidge wrote some lovely nature lyrics. Listen to Rupert Brooke as he sighs for the stirring of branches across the moon by the old church clock in the ancestral village of Grantchester. Love also is a favorite topic of poets—love of man and maid, the special love called friendship, mother-love. There is love in the haunting lines of Coventry Patmore in THE TOYS, ever dear to young and old. The father in this poem fondly loved his son.

Poetry is not limited to the three themes of religion, nature and love. On the pipes of Pan many tunes may be played. There are plenty of these tunes in modern poetry: from earth to heaven and from heaven to earth airy pipings stray. Multiple are the themes therefore in modern poetry. As in a giant mirror we see ourselves reflected when we study the poetry of this long period, from 1800 to the present. Here are beautiful thoughts and deep feelings on the mysterious

adventure that we call life. Here are joy, sorrow, grief, pathos, disappointment, ecstasy, love, hatred, warfare, slaughter, friends, foes, animals, clouds, stars, trees, and battles lost or won.

The eighteenth-century poetry, as we have said, may be called classical. It had to do with far-off, ancient affairs. Its verse was made in stiff patterns. It used many special poetic words—deem, for think; empyrean, for sky, and so on. There were many allusions to scholarly writings, known to only a few readers, those with a classical education. It was, in short, elegant.

WHAT WE MEAN BY THE ROMANTIC MOVEMENT IN POETRY

The nineteenth century was romantic. Its poetry was about simple, everday matters, about feelings common to all men. A greater freedom of form was allowed. Words were, for the most part, the words of everday speech, set in beautiful images that anyone could understand. This was a good thing, because, during the nineteenth century, education was spreading in England. More people could read than in the previous century, yet, these "new" readers did not have the classical education necessary to understand the "elegant" verse of the preceding century.

We have not yet explained why this poetry of common things was called romantic. What does romantic mean? The word refers to a glossing over of any details that would be too painful or ugly. Romantic poetry might be accused of telling the truth, yet not all the truth. Burns's COTTER'S SATURDAY NIGHT is romantic. Thomas Hood's SONG OF THE SHIRT was written in the same period, and is also about a poor worker. It is not romantic, but realistic. The poet does not care how much the reader suffers in reading THE SONG OF THE SHIRT; he wrote in sorrow and bitterness, glossing over nothing.

Toward the end of the nineteenth century, more and more realistic poetry began to appear, and there has been much of it in our century. The twentieth century provides us with a mixture of realism and romance—as in the work of the living poet laureate, John Masefield.

WILLIAM BUTLER YEATS, DREAMY POET OF FAR-OFF LONELY PLACES

Before the first World War a dreamy poet held sway among the young at Oxford and kindred intellectual circles. He was William Butler Yeats, the poet of lonely, peaceful and beautiful things. He yearned for an evensong like the low murmuring of the water by the margin of an island lake. His was a world of restful twilight. A number of poets, many of them Irish, expressed this same desire for dreaming quiet. These became known as "poets of the Celtic twilight." A Scot, William Sharp, who used the pen name Fiona MacLeod, was one of the most famous of these men. George Russell, the Irishman, was another.

The first World War may mark the end of a chapter. From home and school and college and office the young men went forth to fight and die or triumph. They looked longingly back on a world of peace and beauty, now marred and broken by a wild world in arms. Some sang their songs and fell, like Rupert Brooke and Francis Ledwidge. Some sang their songs and survived, like Siegfried Sassoon and Robert Nichols.

Plaintive as the wailing notes of the violin are those war poems. The reader who would understand the place of poetry in the second decade of the twentieth century may well study those war poems. The older poets at home were left to lament the young who struggled in fields of mud and blood and slaughter. Laurence Binyon in his moving poem FOR THE FALLEN expressed the high note of sorrow mingled with the loftier note of pride in those who had made the supreme sacrifice. "At morn, at noon, at the going down of the sun shall we remember them."

LYRICAL POEMS THAT SPRANG FROM GRIM BATTLEFIELDS OF WORLD WAR I

Francis Ledwidge, who perished on a grim battlefield of France in 1916, may bid us pause as we survey the lyrics that sprang from the Western Front in those days. From the green fields of Ireland he had come in the regiment of another Irish poet, Lord Dunsany. The soul of Ledwidge rose above the horror of the trenches. A robin came out on a spring morning to perch on the broken, blackened stump of a tree that had been blighted in the relentless cross-fire. The robin burst into song and the young soldier's thoughts roamed back to the dew-laved fields round his Irish home, to the songs of innumerable robins heard in childhood, to dreams that were born from the enchanting feet of fairies as they made music on an emerald ring of grass, to the lowing of cattle and the bleating of sheep and the purling of crystal streams. Ledwidge summed it all up by saying that "the little fields of home" were calling to him across the world. This is the stuff of poetry: by it our souls are washed.

Siegfried Sassoon gave us his poignant feelings. How bitter was the battle for survival and for freedom amid the churned mud, the barbed wire, the guns pounding, men being blown sky-high into fragments as others sickened and sweated to wait for the grisly bayonet charge at the cold dawn. The poet would like to rush out over the parapet amid the agonized screams of the dying and cry out: "Dear God! O make it stop." Which is the prayer that rises to our lips as we meditate upon war poetry.

The dreaming twilight of Yeats was followed by the bright sunshine of John Masefield. These two had discussed poetry in earlier and more serene days, amid the spacious pleasure-grounds of Lady Gregory's beautiful home in Ireland. Yeats had given his poetic views on the passing show when he sang that "the world is more full of weeping than you can understand." Our best escape from the sorrow, he said, is to come away "with the fairies hand in hand." His friend (and Masefield's), G. K. Chesterton, despite the cruel sallies of fate that assail mankind, defiantly preached that "the world is more full of glory than you can understand." Masefield roused our drooping hearts by bidding us laugh and be merry, laugh till the game is played. Masefield cheered us by insisting that God made this world "for the joy He took in a rhyme." This almost brings us back to the Biblical beauty of Job who was happy when "the morning stars sang together." There are two ways of looking at life, as expressed in the distich:

> "Two men looked out through prison bars;
> One saw mud, the other stars."

It has been observed that "sympathetic insight into animals is the keynote to modern poetry." A good example is the touching poem by James Stephens to a rabbit caught in a snare. The poet can hear the plaintive cry of the agonized animal, and reassuringly exclaims "Little one, O little one, I am searching everywhere!" We are reminded here of the medieval literary spirit of Saint Francis of Assisi, who bade us love all creatures, great and small.

CHESTERTON'S DONKEY THAT HAD AN HOUR OF GLORY AT JERUSALEM

Another popular specimen of sympathy with animals is Chesterton's THE DONKEY. In it the poet shows that even the lowly and despised and derided donkey had its hour of honor and glory amid palm branches and Hosannas at the triumphal entry of Christ into Jerusalem. Winifred Letts, in her affectionate poem to Tim—an Irish terrior—is sure that the dog will one day meet her in heaven, for "Would God be wasting a dog like Tim?"

KIPLING'S BELOVED SUSSEX, "AMONG THE ENGLISH POSIES"

Love of some special region—usually home—may be traced in modern poetry. The beautiful county of Sussex, in the south of England, has occasioned many a verse in our time. This is a county of ancient and lovely villages, of battlegrounds and ancestral castles, of steep white cliffs that fringe a blue sea. Here the Normans fought the Saxons and won, nine centuries ago. Here heroic men kept watch on chalky slope and sandy beach in the dark days of the second World War. Kipling observed that God gave each person a particular spot of earth to love above all others. To him the dearest place was Sussex, where he lived, amid the "English posies."

Hilaire (Hilary) Belloc, though born in France, also chose Sussex—with its "line of the Downs, so noble and so bare." Belloc, himself lonely and austere as some rocky headland, selected his home there, with an uplifting background of treeless, rolling chalk uplands, where cattle and sheep roam for pasture. The scenic beauties of Sussex shine in Belloc's masterly prose; more brightly still are they reflected in his poetry which is clear as some cool, crystal stream. Here beneath an ancient thatched roof would he sit with his companions, believing that there is nothing worth the trouble of winning but "laughter and the love of friends."

SOME OTHER POETS WHO LOVED "SUSSEX BY THE SEA"

In Sussex dwelt Maurice Baring, whose poem on a dead airman may be found in every anthology of modern verse. Of Sussex has Sheila Kaye-Smith sung; and John Drinkwater makes the very breezes that blow on those southern English downlands wail over the youthful that have fallen in defense of home and shire. Francis Thompson's memorable poem, THE DAISY, is set by the Sussex sea and the thistles and harebells of its winsome shore line. This poetic paradise has captured Sir John Squire, Alice and Wilfrid Meynell, and many other moderns.

The southwest country of England claimed the heart of Hardy, where he lived and wrote. The shire is Dorset, but Hardy called it Wessex. Rural life, pastoral life, with those homely joys and longings that inspired Gray's

ELEGY, also proved the permanent theme of Hardy's rich long literary life. His native valleys and knolls were dear to his poetic and contemplative soul.

RUPERT BROOKE, WHO LIES IN "SOME CORNER OF A FOREIGN FIELD"

The colder east coast of England was the scene of Thompson's unforgettable poem THE POPPY, written to a child. The historic old county of Essex on England's east coast inspired Arthur Shearly Cripps among the moderns: he sang of venerable villages with quaint names, such as High Easter and Good Easter. Oxford and its spires have launched loving offerings from the brain of many a balladist—from Oscar Wilde to James Elroy Flecker, who died in his thirty-second year. In the east, Cambridge, that knew Chaucer, found a sweet singer in Rupert Brooke, who strolled like a Greek god among the college playing fields, and perished prematurely in the first World War. His deep love of his homeland is expressed in the oft-quoted lines: "If I should die, think only this of me: That there's some corner of a foreign field that is forever England."

Among the poets who have been charmed by the bustle of London is Alfred Noyes, whose BARREL-ORGAN would have made him famous, had he written nothing else. Barrel-organ is the English name for hurdy-gurdy. In this poem the writer describes the crowded city on a warm spring evening; the workers are "crammed and jammed in buses—and they're each of them alone." Suddenly a barrel-organ starts to grind out a tune, and each tired worker takes refuge in a magical dream. You must have heard the lilting refrain:

> Come down to Kew in lilac-time,
> in lilac-time, in lilac-time;
> Come down to Kew in lilac-time
> (it isn't far from London!)

The beautiful lands of Scotland and Wales have been memorialized in modern song. "Evening on the olden, the golden sea of Wales," said Flecker. The native Gaelic of Scotland has been invoked to do honor to its name and fame.

By the middle of the nineteenth century Thomas Moore had made the name of Erin echo round the seven seas. Killarney and Wicklow and countless beauty spots of Ireland were enshrined in his sweetly polished songs. He gave utterance to deep, dear thoughts that are common to the whole human race, in THE LAST ROSE OF SUMMER and BELIEVE ME IF ALL THOSE ENDEARING YOUNG CHARMS.

TWO GREAT THEATERS DEVOTED TO NOBLE ENGLISH NOBLY SPOKEN

Let us return now to William Butler Yeats, one of the greatest wizards in words since Tennyson. The west of Ireland held his spirit as a poetic captive: beneath that catalpa tree in Lady Gregory's lovely gardens in County Galway, he vigorously discussed the romantic poetry of ancient Ireland with a great master of musical prose—George Moore. They meditated on the loves of bygone heroes and heroines, and wondered how these could be made to live again on the stage of the young Abbey Theatre in Dublin. The Abbey began as a theater devoted to beautiful verse beautifully spoken amid graceful and sincere acting.

It is to the credit of Yeats and the Abbey Theatre, and to the London Theatre, known as the "Old Vic" (Victorian), that poetry and verse on the stage have won back some of the honor which they seemed to have lost. It is fortunate for the dignity of poetry that Shakespeare—"the thousand-souled" Shakespeare, as Coleridge called him—can still compellingly hold the stage in any of our cities, in the Old World or the New. "In nothing is England greater than in her poetry," said Matthew Arnold.

The ancient Irish poet and hero, Ossian, said, "I love the music of the thing that happens." To the Irish, prose has ever been poetry, and poetry, music, and they are both related to action.

JOHN MASEFIELD, POET LAUREATE, SINGER OF THE COMMON MAN

John Masefield, outstanding among the moderns, has given poetry a new place in our commonplace everyday lives. In 1930 he was made poet laureate of England, an honor he richly deserves. Other laureates before him had sung on lofty themes; some were themselves lofty, such as Tennyson; others were dull, such as Alfred Austin, who left a line that says "he fell upon his hands on warm, wet slop."

Masefield was given the poet-laureateship at a time when the common people of England had proved their right to leadership. Masefield had already set forth his themes. He would not sing of the high and mighty, not of the powdered and periwigged, not of lackeys and menials among the pompous, not of princes and potentates. Rather would he sing of the sailor sweeping the deck with his honest hands and sweeping the sea with his tramp steamer. He would sing of the stoker whose eyes are rimmed with soot. He would

sing of the mariner at the wheel, of the nautical engineer at his job, of all that abide by honest toil. In his early years, Masefield gave us songs of the sea that are forever memorable. SEA FEVER is a favorite.

One has to read Masefield in order to find out whether he has made romanticism real or realism romantic. Certainly he has made prosaic things poetic. Remember the burial of the poor sailor as the surviving mariners lament him—has he not gone down among the mermaids "with long green weeds for hair"? Though Masefield can sing of smoke-stacks and fish barrels and cheap tin trays, he can also grow ecstatic over the Lady April who brings daffodils, and over the dawns and sunsets on hills and windy moors that come "in solemn splendor like slow old tunes of Spain."

YEATS'S "LAKE ISLE OF INNISFREE," AN EXAMPLE OF "ESCAPE POETRY"

It is often said, and just as often denied, that the keynote of modern poetry is "escape." We love the poet and his work because he takes us away from a humdrum world of dreary daily routine. Yeats gives us an example of "escape poetry" in his LAKE ISLE OF INNISFREE. In this case we do not have to guess how the poem came to be. The author was asked by girls at an English school if Innisfree were a *real* island. He said it was, in Ireland. He wrote the poem when he was young, living in London, and feeling very homesick—longing to have a real home on a romantic island. Is not this wish common to us all as we tread the city asphalt? We hold it in common with the Greeks who longed for "a blessed isle of rest." Failing this escape, many of us find a measure of happiness, two or three hours long, on a sea of celluloid: motion pictures set amid dreamy music, low lights, gilt mirrors, lovely heroines and handsome heroes. Our tastes may vary as to gods and men, but we all do love to "escape" into a world of imagination in radio, screen, stage and reading.

THE REALISTIC POETS AND THEIR ANGER AT LIFE'S BITTER THINGS

On the other hand, there are modern poets who say that we must get down to the bare hard facts of life and sing of them. Robes of rock and thrones of cloud may be all very well in our dreams, but our grinding existence is cast among coffee cups and steel girders, among street-car tracks and fuming busses, in crowded restaurants and still more crowded subways. Can there be any poetry in these places? Some sturdy moderns have devoted their gallant muse to such harsh and mundane matters, on the theory that poetry should deal with life, should criticize it and appraise it. Why cultivate heaven-pointing architectural tracery? these poets protest. Let us rather show honest anger at the bitter things of life. See, for instance, that lean, ill-clad and hungry child who is too weak to take in the education offered in that out-of-date old school. Thus do some sing.

Yes, there are many voices in modern poetry, from the fairy-like to the fierce, from the calm to the angry. Joseph Mary Plunkett sees the face of God in every flower, and Alfred Edward Housman thinks the devil must rule this orb of ours, it is so full of wars, miseries and wickedness. Gerard Manley Hopkins will declare that the whole world "is charged with the grandeur of God" and that everything deep down is full of sweetness and freshness. Hardy asks why we suffer so much, why our fairest hopes are blasted so soon, why joys swiftly vanish and sorrows come so quickly and stay. Rabindranath Tagore, the Indian, so popular in modern English poetry, bids us purge ourselves of these misgivings, these hatreds, these doubts. Lets us, he urges, contemplate eternal beauty so that we may love our Maker and our neighbor more, and make the world a brighter place. This may be almost called an ethical conception of poetry.

A GREAT ESSAY THAT HELPS US TO UNDERSTAND THE POETRY OF SHELLEY

In the early part of the present century a great essay by a great poet was rejected by an editor who lived to regret it. The reader will do well to study this rejected but now famous essay. It is Francis Thompson's prose masterpiece on the poet Shelley. It is important for its style and content, for its discussion of metre and matter.

Thompson holds that the poet and the child are near akin. Shelley was a great man who remained a great child, and from the wondering simplicity of childhood gave us his world of brightness and light, his airy hues, his hanging gardens of words, his world of fairy toys and "tremendous trifles." "The universe is his box of toys." All of which brings us to the subject of children in modern poetry.

THOMPSON'S EPITAPH: "LOOK FOR ME IN THE NURSERIES OF HEAVEN"

In the famous Kensal Green Cemetery in London is the slab wrought by the sculptor, Eric Gill, over the grave of Francis Thompson. Engraven on this memorial is one line

of Thompson's poetry—taken from the last words in his famous piece To My Godchild. "Look for me in the nurseries of Heaven," says the inscription. Not among the wise and mighty is the poet to be sought. He is to be found among the simple and the child-like.

Padraic Pearse uttered similar poetic words to the Eternal Child when he said: "Among the children I sought you and among the children I found you."

Belloc's well-known poem on Courtesy takes us to the winning and unaffected graces of childhood as he states that "the Grace of God is in Courtesy." Belloc refers to the gentility of the little Lord adored by kings:

> "He was so small you could not see
> His large intent of Courtesy."

Again in his poem "Dedication on the gift of a book to a child," Belloc has a plea for the artless imagination of children. The poet first asks the child not to throw the book around, not to cut the pictures out, not to tear "the beautiful thick pages."

> "And when your prayers complete the day,
> Darling, your little tiny hands
> Were also made, I think, to pray
> For men that lose their fairylands."

A further example of childhood's innocent reverie will be found in Belloc's poem The Birds. More difficult of understanding and more unusual in its construction is Gerard Manley Hopkins' poem The Bugler-Boy's First Communion.

FRANCES ALEXANDER, WHO WROTE "ALL THINGS BRIGHT AND BEAUTIFUL"

In the latter part of the last century, Frances Alexander, wife of the Protestant Archbishop of Armagh, Ireland, presented to literature some songs for little children. Her Burial of Moses is a classic; and a poem which begins with "All things bright and beautiful" may focus our young eyes forever on the eternally simple gifts of this mysterious earth:

> "The tall trees in the greenwood,
> The meadows where we play;
> The rushes by the water
> We gather every day."

It was in the wooded world where these captivating lines were written that General Alexander, renowned hero of the second World War, searched for a leprechaun as a child, round the roots of wind-laden trees.

Sir William Watson, who died poor and obscure in the 1930's, relates the moods of nature to youth, as in his celebrated lyric on the month of April. He bids April "Laugh thy girlish laughter; Then, the moment after, Weep thy girlish tears."

Poems on nature are not hard to find in modern poetry. The call of the country is deep and clear therein. Sometimes it is love of nature in a local region of beauty, sometimes it is love of nature in any and every zone where it may be found.

THE BUTTERFLIES "THAT GOD SENDS STAGGERING DOWN THE ROADS"

The ancient Celtic monks built their dwellings by lovely lakes and streams; and they showed a deep love for animals. Modern echoes of this may be found in Padraic Pearse, who kept a school which the ancient monks would have approved. Loving animal and bird life, Pearse placed a solemn promise of honor upon the pupils of his school never to hurt the feathered throng or to chase the butterflies that "God sends staggering down roads on missions known to Him." He taught his pupils to have "truth on their lips and purity in their hearts" and so to face the world. His poem on a little bird found dead on the school doorstep on a wintry morning is a simple gem:"Little bird, cold to me is thy lying on the flag, little bird that never had an evil thought."

A setting of nature among the radiant joys of childhood is provided in George Russell's Frolic. The background is a golden beach. The children are singing on the golden sands. They race and they dance. Children, sunbeams and waves are all dancing. "They dance to the self-same tune." It is the harmony of Nature's music. Crooning waves, rustling winds, blowing sands, playful sunshine, restless sea, children chanting—all sounds are blended into a symphony for the poet, and "the whole of the world was merry." The children flutter like doves. Like doves, too, their shadows flit upon the burnished sands.

The poetic creed of Charles Kingsley will be well-remembered from the oft-quoted "My fairest child, I have no song to sing you," which ends with the hearty maxim: "Make of Life one grand sweet song."

The note of humorous contradiction is sometimes cast in, like the fly in the ointment, as when G. K. Chesterton requests us to tune our words to our deeds. Why should we sing "Oh! how I love humanity and hate my next-door neighbor!"

Different attitudes to life and nature are revealed in the work of Walter de la Mare and W. H. Davies. It has been suggested that this world of ours is like a river of beauty flowing along, and that some poets make you look upon it as if for the first time and others make you look upon it as if for the last time. There are many poetic moods between the first look and the last look. Davies may make us look upon it as if for the first time, so full of wonder and primal enthusiasm do we become. Even when we come to the beautiful scene a second or third time we are still admiring it with the same cheerful freshness as when first we beheld the marvel. The sun itself does not tire of dancing.

In De la Mare there is a wistful pathos: look thy last on lovely things for tomorrow we may not be here to gaze upon this swiftly-passing loveliness. Pearse's poem, THE WAYFARER, is a case in point: here Pearse confides that "The beauty of the world hath made me sad, this beauty that will pass." He admits that his heart has been joyful at the sight of a leaping squirrel upon a tree, or the sight of little rabbits scampering in a field at evening amid the slanting sunbeams. Nature he has loved in all its moods; the children playing on the sands have delighted him. He is young himself as he goes to his death. "Things young and happy" cause him misgiving, because they are fast-fading:

And then my heart hath told me:
These will pass,
Will pass and change, will die and be no more,
Things bright and green, things young and happy;
And I have gone upon my way
Sorrowful.

John Henry Newman's poem THE PILLAR OF THE CLOUD, which you may konw as "Lead, Kindly Light" reflects the doubts and sorrows and anxieties and final triumph of poetic feeling. Every word in this polished piece is a simple word: most words therein have but one syllable. Newman's voice was stilled in 1890; millions of voices continue to re-echo the touching thought of his poem.

POETS HARD TO UNDERSTAND: GERARD MANLEY HOPKINS AND THE SITWELLS

As in the case of art and of music, there have been new trends and tendencies and developments in poetry. Hopkins, who died in the 1880's, brought forth a new technique which you may some day study. The poetry of Hopkins is not easy to read. The form, the pattern, is complicated; and the meaning of the words comes to the reader in small sparks, not in a single flash.

Another mode was ushered in by the Sitwells—two brothers and a sister, Osbert, Sacheverell and Edith. Other moderns talked of verse as "futuristic" and "free." Previously recognized masters of song were attacked or cast into the discard—the delicate tracery of Tennyson suffering repeated assaults. Most of the new schools of writing demand that we say what we want to say briefly, tersely and originally, since our buzzing mechanistic age has no time to waste. The snappy idiom of the telegraph office is sought.

But Tennyson and the older masters still sit on their thrones. What can be said of the new-fashioned writers? It would be idle to forecast who will be read in a hundred years. Meanwhile the "battle of the books" must continue. In any case, as a modern writer of classic sonnets, Lord Alfred Douglas, expressed it, great poetry is usually found in small quantities. We may achieve it or find it only after toil and labor similar to the task of digging the nugget of gold from the rock.

In modern poetry the note of humor is not wanting, as when F. W. Harvey wrote on DUCKS. God must have made the duck for fun says the poet, and He must be laughing still "at the comical sound that comes out of its bill."

Critical sarcasm and lampoon have demanded why some modern poets are here at all. Satirists have become sad, because it is increasingly difficult to write satire—on the ground that, no matter how absurd the satire, it still reads more sanely than the thing which has just been satirized.

Why not discover your own taste in poetry, by copying into a loose-leaf scrapbook the poems you like, as you come across them? Be sure you start each new poem on a fresh page. There is a good reason for this. You will find yourself looking at poems critically, asking do I like this one well enough to put it into my collection? How about this one?

At the start, you may be easily pleased. As you progress with your hobby, your critical sense will develop; and you will doubtless want to throw out some of your earlier choices. Later still you will want to arrange your collection by verse forms (sonnets, ballads, lyrics); or by authors; or by subjects.

A good hobby "stretches the mind," as someone has said. Making a poetry collection may stretch the mind and the spirit too, the best exercise in the world!

By MAURICE LEAHY.

THE NEXT STORY OF LITERATURE IS ON PAGE 4625.

BRITISH POETS OF THE NINETEENTH CENTURY

Below you will find a list of poems and volumes of verse written by important British poets of the nineteenth and twentieth centuries. Many of these poems are included in the poetry sections of THE BOOK OF KNOWLEDGE. If you like this sampling, you may want to read some of the longer poems, or even the volumes of verse, we have recommended here.

Many of these men and women have written many times as much poetry as we have included in this list; but we have selected those works which are best known and most interesting. Then, too, many of them have written stories and plays, novels and essays and other prose works which are not included here at all. A listing of these prose works will be found in other chapters of THE BOOK OF KNOWLEDGE.

Frances Alexander (1818-1895)
- VERSES FOR HOLY SEASONS
- HYMNS FOR LITTLE CHILDREN

Matthew Arnold (1822-1888)
- DOVER BEACH
- THE FORSAKEN MERMAN
- REQUIESCAT
- CROMWELL
- MEROPE

William Blake (1757-1827)
- THE NEW JERUSALEM
- NIGHT
- THE PIPER
- SONGS OF INNOCENCE
- SONGS OF EXPERIENCE
- PROPHETIC BOOKS

Elizabeth Barrett Browning (1806-1861)
- A CHILD'S THOUGHT OF GOD
- A MUSICAL INSTRUMENT
- SONNETS FROM THE PORTUGUESE
- AURORA LEIGH
- LAST POEMS

Robert Browning (1812-1889)
- EARL MERTON'S SONG
- HOME-THOUGHTS FROM ABROAD
- HOW THEY BROUGHT THE GOOD NEWS FROM GHENT TO AIX
- INCIDENT OF THE FRENCH CAMP
- THE PIED PIPER OF HAMLIN
- PROSPICE
- SONG FROM PIPPA PASSES
- PARACELSUS
- BELLS AND POMEGRANATES
- DRAMATIC IDYLLS
- ASOLANDO: FANCIES AND FACTS

George Gordon Byron (1788-1824)
- THE DESTRUCTION OF SENNACHERIB
- OCEAN
- SHE WALKS IN BEAUTY
- THE ISLES OF GREECE! THE ISLES OF GREECE!
- WE'LL GO NO MORE A-ROVING
- ODE ON VENICE
- CHILDE HAROLD
- THE CORSAIR
- THE PRISONER OF CHILLON

John Clare (1793-1864)
- POEMS DESCRIPTIVE OF RURAL LIFE AND SCENERY

Samuel Taylor Coleridge (1772-1834)
- GLYCINE'S SONG
- CHRISTABEL
- THE RIME OF THE ANCIENT MARINER
- KUBLA KHAN

Ernest Dowson (1867-1900)
- THEY ARE NOT LONG
- VERSES

David Gray (1838-1861)
- IN THE SHADOWS
- LUGGIE

Thomas Hardy (1840-1928)
- THE DYNASTS
- COLLECTED POEMS

Thomas Hood (1799-1845)
- I REMEMBER, I REMEMBER
- NOVEMBER IN ENGLAND

Gerard Manley Hopkins (1844-1889)
- PIED BEAUTY
- THE BUGLER-BOY'S FIRST COMMUNION
- POEMS

Leigh Hunt (1784-1859)
- ABOU BEN ADHEM
- JENNY KISSED ME
- THE GLOVE AND THE LION
- THE STORY OF RIMINI

John Keats (1795-1821)
- A THING OF BEAUTY
- LA BELLE DAME SANS MERCI
- ODE ON A GRECIAN URN
- ODE TO A NIGHTINGALE
- ON FIRST LOOKING INTO CHAPMAN'S HOMER
- THE EVE OF ST. AGNES

Charles Kingsley (1819-1875)
- THE SANDS OF DEE
- THE THREE FISHERS
- THE TIDE RIVER
- ANDROMEDA
- POEMS

George Meredith (1828-1909)
- LUCIFER IN STARLIGHT
- POEMS AND LYRICS OF THE JOY OF EARTH
- BALLADS AND POEMS OF TRAGIC LIFE
- LAST POEMS

Thomas Moore (1779-1852)
- BELIEVE ME, IF ALL THOSE ENDEARING YOUNG CHARMS

BRITISH POETS OF THE NINETEENTH CENTURY

Thomas Moore (*continued*)
The Last Rose of Summer
Canadian Boat Song
The Harp That Once through Tara's Halls
Irish Melodies
Lalla Rookh

John Henry Newman (1801-1890)
The Pillar of The Cloud
Verses on Religious Subjects
The Dream of Gerontius

Coventry Patmore (1823-1896)
The Round of the Year
The Toys
Odes
Amelia

Christina Rossetti (1830-1894)
A Birthday
Uphill
Goblin Market
Sing Song

Dante Gabriel Rossetti (1828-1882)
The Blessed Damozel
Ballads and Sonnets
Collected Works

Sir Walter Scott (1771-1832)
Coronach
Hunting Song
Lochinvar
Lullaby of an Infant Chief
My Native Land
Old Christmas
Lady of the Lake
Minstrelsy of the Scottish Border
The Lay of the Last Minstrel

William Sharp (1856-1905)
Earth's Voices
Romantic Ballads and Poems of Fancy
Flower o' the Vine

Percy Bysshe Shelley (1792-1822)
Ode to the West Wind
To A Skylark
Ozymandias of Egypt
To the Night
Music, When Soft Voices Die

Percy Bysshe Shelley (*continued*)
Prometheus Unbound
Adonais
Queen Mab

Alexander Smith (1830-1867)
City Poems

Robert Southey (1774-1843)
The Battle of Blenheim
The Well of St. Keyne
The Inchcape Rock
The Cataract of Lodore
Joan of Arc
Thalaba
Madoc

Algernon Swinburne (1837-1909)
Atalanta in Calydon
The Garden of Proserpine
Poems and Ballads
A Song of Italy
Songs Before Sunrise

Alfred Tennyson (1809-1892)
The Princess
Break! Break! Break!
The Bugle Song
Crossing the Bar
Idylls of the King
Charge of the Light Brigade
The Lady of Shalott
Locksley Hall
In Memoriam

Francis Thompson (1859-1907)
Little Jesus
The Daisy
The Hound of Heaven

Oscar Wilde (1854-1900)
The Ballad of Reading Gaol
The Sphynx

William Wordsworth (1770-1850)
Daffodils
Ode to Duty
Sonnets dedicated to Liberty
Ode on Intimations of Immortality
She Was a Phantom of Delight

BRITISH POETS OF THE TWENTIETH CENTURY

Richard Aldington (1892-)
Collected Poems
Crystal World

Wystan Hugh Auden (1907-)
Poems
The Dance of Death

Maurice Baring (1874-1945)
The Black Prince
Selected Poems

Hilaire Belloc (1870-)
Verses and Sonnets
The Bad Child's Book of Beasts

Laurence Binyon (1869-1943)
Collected Poems

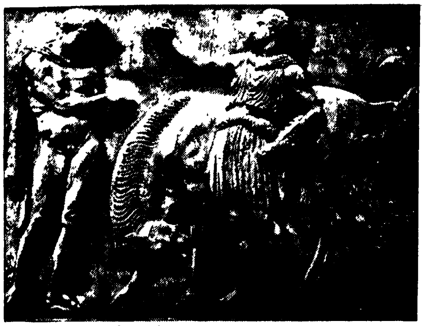
Edmund C. Blunden (1896-)
The Shepherd
Halfway House

Robert Bridges (1844-1930)
Eros and Psyche
The Testament of Beauty

Rupert Brooke (1887-1915)
The Soldier
Peace
The Dead

Edward Carpenter (1844-1929)
Towards Democracy
G. K. (Gilbert Keith) Chesterton (1874-1936)
The Donkey
Wine, Water, and Song
The Ballad of St. Barbara
The Queen of Seven Swords
Padraic Colum (1881-)
An Old Woman of the Roads
Wild Earth
Old Pastures
Flower Pieces
William H. Davies (1871-1940)
Leisure
A Poet's Pilgrimage
Moss and Feather
The Loneliest Mountain
Walter de la Mare (1873-)
The Buckle
An Epitaph
The Listeners
Collected Poems
John Drinkwater (1882-1937)
Swords and Ploughshares
American Vignettes: 1860-1865
Edward Dunsany (1878-)
Poems
Mirage Waters
James Elroy Flecker (1884-1915)
Selected Poems
Frank S. Flint (1885-)
Cadences
Otherworld
Wilfrid W. Gibson (1878-)
Highland Dawn
The Alert
Radclyffe Hall (?-1943)
'Twixt Earth and Stars
Ralph Hodgson (1871-)
Time, You Old Gipsy Man
The Bull
Eve
The Bells of Heaven
A. E. (Alfred Edward) Housman (1859-1936)
A Shropshire Lad
Last Poems
More Poems
James Joyce (1882-1941)
Chamber Music
Ecce Puer.
Sheila Kaye-Smith (1888-)
Willow's Forge and Other Poems
Saints in Sussex
Rudyard Kipling (1865-1936)
If
Recessional
The Overland Mail
Barrack Room Ballads
Gunga Din

D. H. (David Herbert) Lawrence (1885-1930)
Birds, Beasts, and Flowers
Francis Ledwidge (1891-1917)
Songs of the Field
Songs of Peace
Thomas MacDonagh (1878-1916)
Lyrical Poems
John Masefield (1878-)
Sea Fever
Spanish Waters
Cargoes
Salt Water Ballads
Alice Meynell (1850-1922)
Chimes
My Heart Shall Be Thy Garden
The Shepherdess
Harold E. Monro (1879-1932)
Ballads and Poems
Alfred Noyes (1880-)
The Barrel-Organ
The Torch Bearers
Ballads and Poems
Padraic Pearse (1879-1916)
The Wayfarer
Poems
Joseph Mary Plunkett (1887-1916)
The Circle and the Sword
Poems
George William Russell ("AE") (1867-1935)
Selected Poems
Midsummer Eve
Voices of the Stones
Siegfried Sassoon (1886-)
I Lived My Days Apart
Rhymed Ruminations
Collected War Poems
Edith Sitwell (1887-)
Selected Poems
Osbert Sitwell (1892-)
Argonauts and Juggernauts
Out of the Flame
Sacheverell Sitwell (1897-)
The Hundred and One Harlequins
The People's Palace
Stephen Spender (1909-)
Ruins and Visions
Sir John Squire (1884-)
The Lily of Malaud and Other Poems
Poems of Two Wars
James Stephens (1882-)
Collected Poems
John Millington Synge (1871-1909)
Deirdre of the Sorrows
Poems
Walter James Turner (1889 or 1890-)
Selected Poems
William Butler Yeats (1865-1939)
The Wind Among the Reeds
The Lake Isle of Innisfree




Graceful and spirited figures from the Parthenon frieze, in lines of rhythmical beauty.

THE GOLDEN YEARS OF GREECE

THE three greatest sculptors of Greece were Polyclitus, Myron and Phidias (or Pheidias). Most of their original statuary has been lost; some fragments remain, and certain copies. You may ask, seeing that the mass of this ancient work has disappeared, how it is that we can so confidently declare that these sculptors share the supreme genius of the world.

The answer to that is Pausanias and a few others, but chiefly Pausanias. He lived in the second century after Christ, was a great traveler, and wrote many books, including a description of Greece. He wrote fully and carefully about the buildings and sculpture, and his history is invaluable. Other men more gifted as writers had composed treatises and essays on Greek art, but much of their work is lost. That of Pausanias was mercifully preserved.

Suppose that one of our great cities —London or Paris or New York—was to be overthrown and other cities built up on the ruins. Then, suppose that two thousand years after the time of destruction the new generations, to whom the city had been but a name and a legend, should be able to realize what it had looked like by reading a description written in the days of its glory.

This is the service men like Pausanias and Pliny have rendered: they make an old civilization clear to the eyes of a new and different people. We have identified from their descriptions many fragments excavated, and have found in other lands many copies of original sculpture which they mentioned. But a number of the statues by Greece's greatest men we have to take on trust, or accept through the medium of marble copies made at a much later period.

Such lost treasures are the Hera—a colossal statue in ivory and gold by Polyclitus—described by Pausanias. Of it no trace remains, and the famous athletes by the same sculptor are represented only by copies.

Polyclitus worked during the latter half of the fifth century. He followed Agelados, the ancient sculptor of Argos, in whose studio, or workshop, Polyclitus, Myron and Phidias are said to have passed their apprentice years, and when the veteran sculptor died, Polyclitus succeeded him as head of the Argive school.

We must remember that it was the blending of these Doric schools of the Peloponnesus, such as Argos, Sicyon and Olympia, with those of the Ionian schools, whose head was Athens, that produced the ultimate greatness of Greek art.

The sculpture of Argos, Sicyon and Olympia was naturally affected by the daily life of the nation. And the interests of men centred in the Olympian games held every fourth year.

To the Dorians the perfect young man was the one whose body was so admirably built and disciplined that he could make it endure the most arduous physical tests. Running, boxing, wrestling, throwing the javelin and the quoit or discus—these were part of the exercises practiced continually, and publicly performed at the great festivals by the youth and young manhood of Greece. Oh, the glories of triumph, the cries and excitement of the huge crowds, when the winner came up to the judge to receive the victor's wreath!

THE VICTOR IN THE GAMES WHOSE STATUE WAS SET UP AT OLYMPIA

All this is but faint and dim to us, like songs in a fairy tale, but as the life of old Greece becomes plainer through her art we must surely admire the aspect of it; for there are few spectacles finer than that of a young man denying himself many things in order that his body may be kept in complete mastery.

The victor's wreath—looked upon as the final glory by many a boy of seven who was yearning for his manhood—was not the athlete's only reward. For certain games a statue of the winner was set up at Olympia. It is interesting to note that only after a winner had been successful three times was the statue made to resemble him—to become a portrait. Otherwise, it was just a type of an athletic youth labeled with the name and honor of the victorious one.

The effect of this "sport" on the sculpture of the day, in Olympia, Argos and Sicyon particularly, was tremendous. There was always a place in every town where youths congregated to practice for the festival, and there sculptors could watch the beautiful naked bodies to their heart's content. And seeing thus continually the human form, perfectly developed, in glorious play, completely subject to the will, the sculptor could hardly help reflecting this spirit and poetry of movement in his work.

It was to be expected, also, that athletic vigor rather than reposeful beauty, a certain harshness at times, a crudeness, should mark this work of the Doric schools of the Peloponnesus, in contrast to the Attic school. The whole spirit of Athens was different. The Athenians were a finer, subtler people, more ease-loving, perhaps. Certainly they were given more to mental and imaginative than to physical exercises.

THE ARTISTS AND THE STORY-TELLERS IN THE STREETS OF OLD ATHENS

In the old city of Athens artists could see, as they passed through the bright streets above the windy sea, philosophers talking together, and could stop and share their converse. They could pass into the hall and hear statesmen speaking of the eternal principles of liberty and of ideals, could hear Pericles himself making an oration.

These artists could see in another place a story-teller reciting one of the books of the Iliad, surrounded by men, women and children who wept and scarcely breathed as they heard of Achilles going forth to slay Hector, of the long chase round the walls of Troy, and the fight, and the death of the Trojan hero:

"Thrice round Priam's city circled those twain with flying feet, and all the gods were gazing on them.

"But when the fourth time they reached the springs; then the father of the gods hung his golden balances, and set therein two lots of dreary death, one of Achilles, one of Hector, and held by the midst and poised. Then Hector's fated day sank down, and fell to the house of Death."

THE SCULPTORS WHO TRIED TO SHOW THE MIND BEHIND THE FACE

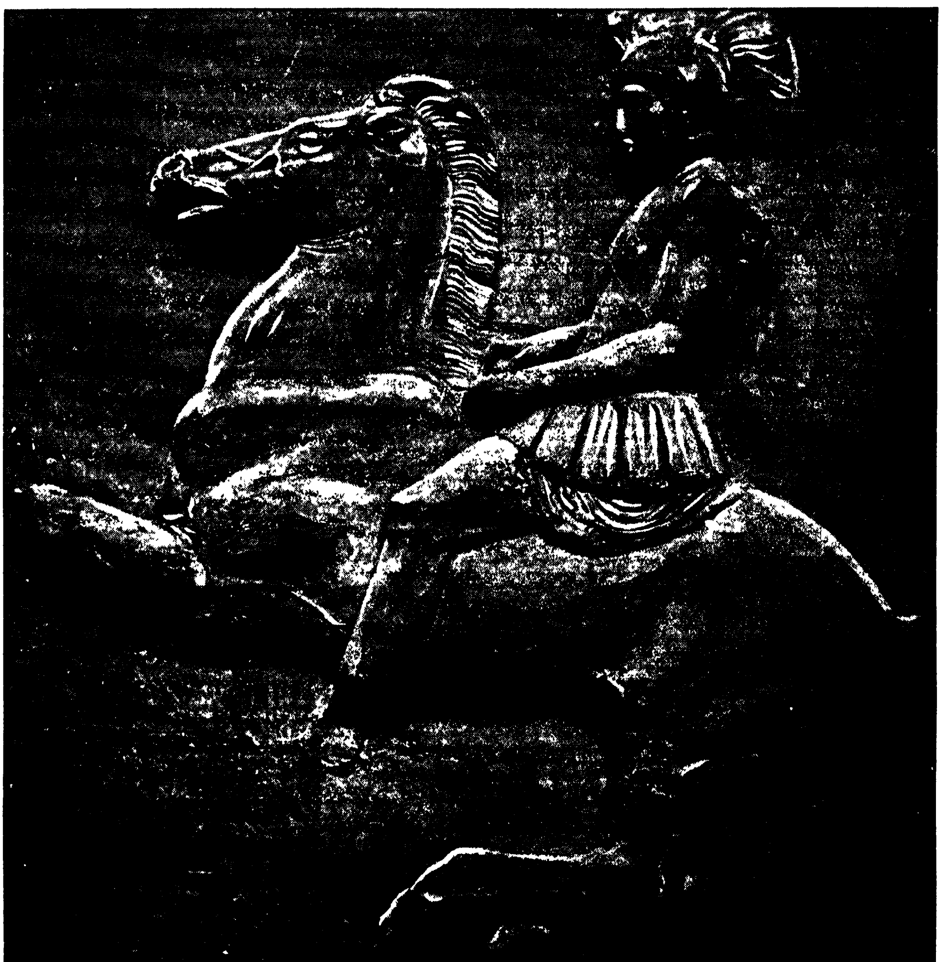
While the story-teller was reciting Homer's lines, in the distance, up on the Acropolis, could be heard the sound of workmen's labor, for the snowy marble mass of the Parthenon was rising on the ruins the Persians had left—but we shall be thinking of that later.

In glorious Athens, then, sculpture was of another kind from that made by the artists of the other states; it found its height in the grand and spiritual qualities of Phidias. It was concerned more with thought than with action. The Athenian sculptors struggled to express the beauty of thought behind facial features, strove to render in marble those changes of expression that betray happiness and sorrow, pleasure or discontent; whereas to the Doric sculptors, if a face was perfect in proportion, that sufficed. And we see how these forces, the spiritual and the physical, when they were blended, made the miracle of Greece in her golden years.

Greek and Centaur fighting on a metope of the Parthenon.

A Caryatid from the Erechtheum.

A Greek and Centaur group on a metope of the Parthenon.



A horseman from the Parthenon frieze, now in the Elgin Room of the British Museum.

POLYCLITUS AND HIS WONDERFUL FIGURE OF THE IDEAL ATHLETE

The most famous work of Polyclitus of Argos was sculpture of an athletic type. He may be said to have founded the athletic sculpture which became so marked a feature in the art of the Peloponnesus. Two statues in bronze earned for Polyclitus a wide renown. The more famous of the two, called Doryphorus, became known as the Canon, or Rule. It was a man's figure supposed to be of such perfect proportions that the world might refer to it as a standard. And many an argument in an Argive studio concerning this or that work by a rising genius, whose youthfulness made him conceited, may have been silenced by "Compare it with the Canon."

The Doryphorus is not a portrait of any given person: it is the ideal athlete. It shows a man holding a spear sloping against his shoulder, and the original statue of Polyclitus was in bronze. This was destroyed long ago, and we are indebted to copies which, however fine, can only incompletely represent the original. Moreover, a bronze statue reproduced in marble is sure to suffer. Many of the copies that remain of Polyclitus' work were made in Roman times; the best-known copy of the Doryphorus, now in the Naples Museum, was found at Herculaneum.

THE VICTOR IN BRONZE, AND THE GOLD-AND-IVORY GODDESS

Of the other famous athlete Polyclitus made, also in bronze, there are again only copies left; the best are in the British Museum. This statue is called Diadumenus. It shows a victor at the Olympian festival binding about his brow the sacred band, or fillet, whereon the judge would presently place the victor's wreath.

The wonderful Hera (queen of heaven in Greek mythology) in gold and ivory that was set in the Heræum, near Argos, showed very effectively that Polyclitus was capable of a great flight of imagination and beauty, and that his work was not all of the athletic type. But of this lovely goddess, described by several ancient writers, so far no copies have been found.

Polyclitus perfected another type of statuary—the Amazon. The type was used by many other sculptors of his day, and it figures largely in the work of succeeding generations. The Amazons were well-built, muscular women whom legend represented as coming over from Asia to fight a certain tribe of the Greeks. When, just after the Persian Wars, these mythical persons were introduced into Greek art, the form they took was an act of imagination on the part of the sculptor, and in the popular mind the legendary fights between the Amazons and the Greeks were easily made to stand for the recent struggle with the Persians.

The Amazon as shown by Polyclitus was a powerful woman, essentially Greek, and as nearly like a male athlete as her sex would allow. She wore the simplest short garment, a *chiton,* and had broad shoulders and narrow hips.

HOW POLYCLITUS BROKE AWAY FROM AN OLD FASHION

To the sculptors of the Argive school, headed by Polyclitus, only beauty and perfection of form were essential. They troubled so little about facial expression in their statues that most of the faces could have been exchanged one for another without anyone's noticing the change. This same tradition holds in the Amazon type created by Polyclitus. The women have beautiful, calm, unmoved faces wherein, though they are generally shown wounded and emerging from a fight, no trace of pain or struggle is allowed to show. Later representations of the Amazons break away from this tradition and show a certain amount of emotion.

But although he followed this convention of the "mask" face, Polyclitus was the chief man in his generation to break away from another and more powerful convention, and the effect of this change on Greek art was of lasting importance. Until his day the Greeks had kept to the Eastern habit, made powerful by four thousand years of Egyptian practice, of showing a man with both feet resting squarely on the ground and the weight of the body divided between them.

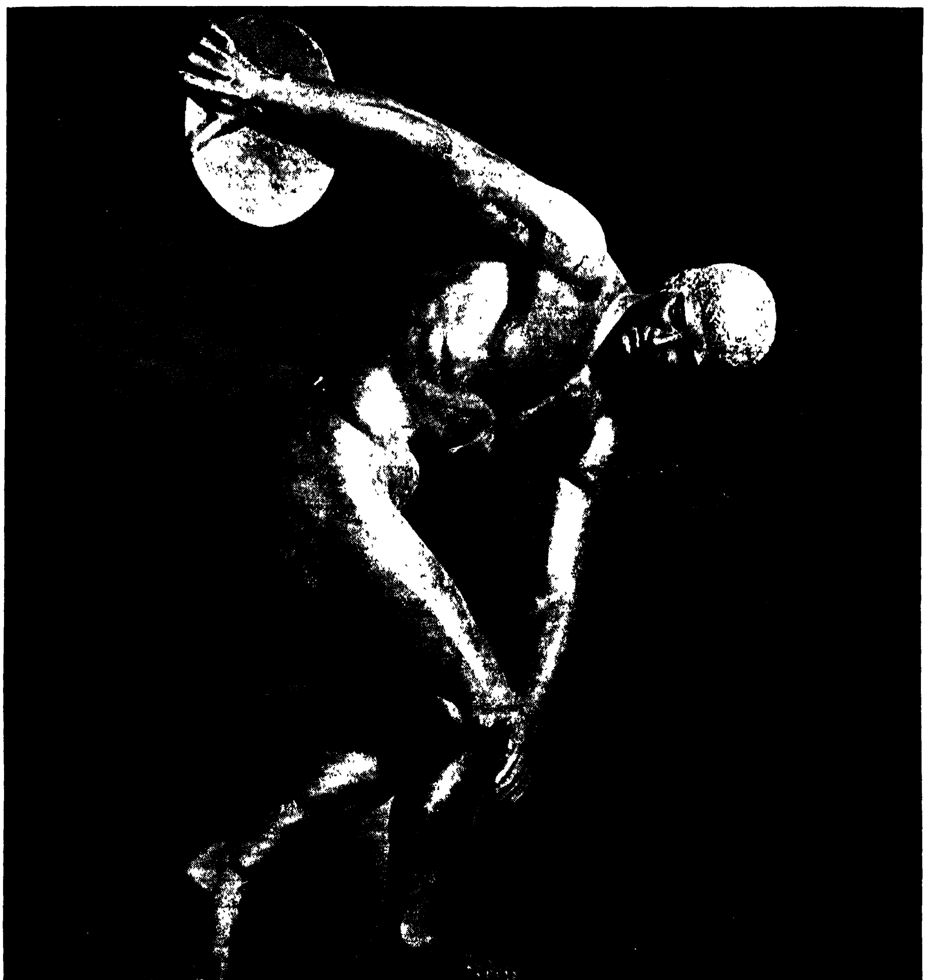
Polyclitus had watched men enough to know that this was not natural, and he had sufficient imagination to see the possibilities opening to sculpture if the convention were done away with. He therefore began to make statues with one foot free, its toes resting lightly on the ground, the weight of the body being supported by the other foot. All his important statues show this new pose, and it was freely adopted by other sculptors.

NOBLE WORKS BY GREEK SCULPTORS

Juno, now in the Elgin Room of the British Museum.

The Head of Athene, by Phidias.

The Head of Æsculapius, now in the Elgin Room.



A reconstruction of Myron's beautiful statue of the Discobolus.

THE YOUTH OF ANCIENT GREECE KNOWN THROUGHOUT THE WORLD TO-DAY

Another tradition of the ancient East was shattered triumphantly by Myron, a contemporary of Polyclitus. The Egyptians had decreed that the centre line of a sculptured body should always be vertical. Myron broke away from this very triumphantly. The chief specimen of his work on the new lines is known, by means of plaster casts, to almost every art student in the world. It is called the Discobolus, and shows a youth bending forward making ready for the act of hurling a discus. The plaster casts are taken from a fine copy of the original, now in Rome.

Though it is said that Myron passed his student years with Polyclitus in the studio of the Argive sculptor Agelados, he worked in Athens and is generally called an Athenian. He shares with Polyclitus the chief place in the sculpture of athletes. But Myron shows the influence of the Attic school in his work. The ideal of the Doric school was pure physical force, rather heavy and reposeful; that of the Attic school was agility. And the faces in Myron's sculpture are lighter and more individual than those of Polyclitus.

A fine example of Myron's work, much talked of by ancient writers, was the statue of Ladas, the famous runner who died after winning the long foot-race at Olympia. The statue of the dying athlete was vivid and powerful in spirit, the emotions of the tragic hour were clearly shown in the face and gesture of the runner—the sureness of victory, the single purpose of reaching forward to the victor's crown.

THE MASTER OF SCULPTURE WHO BELONGS TO ALL TIME AND TO THE WORLD

A great many fine statues in bronze were made by Myron, but only copies of them remain. One of the best is Marsyas the satyr, a copy of which is in the Lateran in Rome. It shows Marsyas about to pick up the flute Athene had thrown down, and starting back as he suddenly sees the goddess confronting him.

Polyclitus and Myron would have made any epoch remarkable. It happens that they were contemporary with the supreme master of Greece, Phidias, and so are apt to be a little overshadowed.

And Phidias alone would have glorified a whole century and made any country immortal. His work was the fine flowering of the Attic ideal, and this was a threefold ideal: a spiritual conception of subject, a unique sense of beauty, and a passion for perfection. These forces meeting in Phidias set him apart; he belongs, not to any country or period, but to all time and to the world.

Pausanias and other writers taken together create a word-picture of Phidias' greatest sculpture. He made so many huge statues that one wonders how the work was ever achieved at all. The two most famous are the figure of Zeus, father of the gods, set up in the temple at Olympia, and that of the goddess Athene, in the Parthenon. Both were in wood, covered with sheets or plates of gold and ivory, a combination to which the Greeks gave the name of *chryselephantine.*

THE WONDERFUL BEAUTY OF THE COLOSSAL STATUES OF PHIDIAS

Of these two statues, so supremely grand in conception and execution, it might be said that they, being dead, yet live. For they were of such a quality that ancient writers, accustomed to the wealth of Greek sculpture, spoke of them with awe and reverence; they recognized Phidias as more than a sculptor, a worker in gold and ivory, a maker of statues of a colossal size—he was the sculptor of the ideal. And in this way the work of Phidias, added to the robust athleticism of Myron and Polyclitus, rounds up and makes complete the golden years of Greek art.

The Zeus at Olympia was so huge, being about seven times life-size, that, as one writer said, the father of the gods could not have risen from his throne without putting his head through the temple roof. The Athene Parthenos, too, was colossal. Figures wrought on such a scale cannot fail to be awe-inspiring. But to the majesty of the sculpture was added that indescribable spiritual quality with which Phidias imbued his work, so that for all time his Zeus has remained unchallenged, the highest pagan ideal of a god who must be portrayed with the form and lineaments of a man.

The throned Zeus seems to have been one of the wonders of the old world. You will find a picture showing a modern idea of it on page 2608. The throne itself was worked in gold, ivory, ebony and precious stones, and is considered the

finest specimen of Greek decorative sculpture. Many pages could be spent describing the carvings which filled every possible space and yet were subservient to the whole gigantic figure. Phidias spared no pains in the "details" of his statues, and he owed his downfall to this very care.

It would seem that men like Phidias ought to be divinely armed against the "slings and arrows of outrageous fortune," to be left free of all trouble for the sake of their work. But it generally happens that by their very delicacy of soul they are more easily harmed than are most of their fellowmen.

THE ATHENE OF THE PARTHENON AND THE FATE OF PHIDIAS

To one of the figures on the shield of the great Athene may be traced the lamentable end of Phidias' life. Around the immense shield whereon the goddess rests her hand the sculptor carved details from the battle of the Greeks and the Amazons. He placed himself and Pericles (the head of the Athenian State) together among the combatants, and something in the way they were represented incurred the wrath of the great statesman. Whether Phidias was put to death, or banished, or voluntarily exiled himself, we do not know, but we know that clouds of jealousy and bitterness made a tragic darkness of his last years.

This Athene, the centre of so much talk and praise, was not the only statue of the goddess made by Phidias. Several are mentioned by ancient writers and are preserved by way of copies made in Roman times and on the coins of the period. One of these statues, executed in Phidias' early years, was a huge Athene in bronze which stood in the open space on the Acropolis. But it was the ivory-and-gold Athene set inside the Parthenon that became the wonder of Greece.

A copy of this, the Athene Parthenos, was found at Athens in 1880 by excavators. Our art museums have casts of the copy. But we should remember, when we look at one of them, that the Roman sculptor who made the marble copy, though he may have reproduced it as faithfully as he could, probably failed to catch the spirit of the original. It is likely, too, that the pillar he placed under the goddess's right hand, or something like it, may have been introduced long after the death of Phidias for the purpose of supporting the statue.

The lovely ivory-and-gold Athene, and probably the Zeus, were demolished in a reaction against the spirit of Greece when the great ancient empires had fallen.

One of the worst misfortunes that ever happened in the course of world development was the destruction of the greater part of Phidias' sculpture. In order to get some idea of what his glorious work was like, let us think about the finest bits that we have left—the fragmentary sculptures of the Parthenon.

The Parthenon was a rectangular building surrounded by a row of columns. Above the architrave surmounting the columns was a series of sculptured panels called *metopes,* separated by *triglyphs*—panels which were decorated with vertical lines and grooves to represent little columns. Round the four outside walls of the temple itself, inside the colonnade and under the ceiling of the portico, ran the frieze—an unbroken band of sculpture in low relief placed at a height of thirty-nine feet. In the metope panels are groups skillfully fitted into the spaces. They represent struggles between gods and giants, between Greeks and Amazons, and between Greeks and Centaurs. Of these you have examples on page 4217.

THE PARTHENON FRIEZE, A PROCESSIONAL PAGEANT IN STONE

The whole frieze, which is about four feet from top to bottom and extends to a length of 523 feet, is devoted to a long procession, a usual feature of a great religious festival held in Athens every four years. During the festival a great number of people of all classes gathered together to carry from the town to the Acropolis a sacred robe specially woven for a certain very ancient wooden statue of the goddess Athene kept in the Erechtheum. In his sculptured picture Phidias made it a glorified procession, a pageant in stone embodying the spirit of all processions the world has ever known. At the east end of the building he shows the gods and goddesses with the priest and priestess of Athene and the city magistrates waiting. Along both sides and across the western end the spirited procession moves—horsemen and musicians, animals for sacrifice, chariots and their drivers, youths and maidens. The figures, for all their variety, give a sense of rhythm and balance, like splendid music.

Over the metopes and triglyphs at either end of the building, in the great

triangular spaces of the pediments, or gables, were groups of statues telling stories connected with Athene. In the east pediment is represented the legend of her birth, full-armed, from the head of Zeus; in the west pediment, the contest between the goddess and Poseidon, god of the sea, for supremacy in Athens. In the central part of each pediment is a group, instead of the single figure used in the older temples. And while the postures of all the figures fit them exquisitely into the parts of the triangle where they are placed, there is no stiffness, no unnatural posing. The beauty of these figures when they were in their perfection can hardly be imagined. We may well believe that the world has never seen more marvelous and beautiful sculpture than that of the Parthenon.

WHY THE PARTHENON SCULPTURES ARE IN THE BRITISH MUSEUM

This lovely marble building was ruined in an explosion in 1687 during the siege of Athens, then a Turkish possession, by the Venetians. In the early part of the nineteenth century the fragments of marbles which had been thrown down, and lay covered with the débris of two hundred years, were rescued and carried to England by Lord Elgin. They are now in the British Museum, and are popularly called the "Elgin Marbles." These fragments of sculpture have been put together with great care, and by the help of imagination we can see something of their meaning. A far greater flight of imagination is necessary before we can see in the mind's eye the whole unbroken mass of the Parthenon—pillars, friezes and sculptured panels—agleam in the sun.

The work of putting together the fragments Lord Elgin had saved was greatly helped by the study of the drawings of a French artist named Carrey, who had sketched the sculpture of the Parthenon while the walls were almost intact, a few years before the Venetian bombardment.

In the Elgin Room, where the marble fragments of the frieze, metopes and pediments are set up, they are helped here and there by casts of the remaining portions which are preserved at Athens. With patience and imagination we can reconstruct for ourselves something of the noble spectacle. The frieze is the most easily understood. The figures almost seem to move; a wonderful grace lightens them.

There is nothing in art more astonishingly fine than the movement and drapery of these broken marbles, to be best seen in the group of headless Fates from the east pediment. It is difficult to believe that hard marble can so give the feeling of soft, clinging robes.

No one has been able to ascertain how far the Parthenon marbles were directly the work of Phidias; the probability is that they were all supervised and directed by him and that part of them came under his own hand.

It would seem as if the work of the whole generation had caught something of the master's genius. The spirit of Phidias guided and stamped other buildings on, or near, the Acropolis, even though their erection may have been of a later date. These were the Erechtheum, the Theseum, and the little temple of Athene Nike (usually called the temple of the Wingless Victory). The noble figures of maidens, the caryatids, which take the place of columns in the portico of the Erechtheum, are in the style of Phidias, strong and in graceful repose. And the outer frieze and balustrade sculptures of the little Nike temple are most beautiful and graceful.

THE TORCH OF PHIDIAS THAT WAS SLOW TO BURN OUT

In the British Museum, near the Elgin Marbles, is another frieze, dating from the fifth century B.C. and taken from the temple of Apollo at Phigalia, in Arcadia, built by Ictinus, the architect of the Parthenon. Less powerful and interesting than the Parthenon frieze, it shows figures of Greeks and Amazons and Greeks and Centaurs in combat.

Among the fine specimens of Greek sculpture of this period is the so-called Throne of Venus, in Rome. It shows the birth of Venus from the sea, while other reliefs show Venus as a girl playing the flute and as a matron holding an incense-box.

Like most great artists, Phidias had a large following of pupils and helpers. The torch that he handed on was slow to burn out. His two most famous pupils, Agoracritus and Alcamenes, carried his traditions far; and it must have been someone who had felt the inspiration of Phidias who made the lovely Venus of Milo, which in 1820 was discovered on the island of Melos and is now in the Louvre.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 4327.

All pictures, U. S. Weather Bureau

"Bad weather coming," reports the weatherman. It may be a blizzard, a tornado or a heavy rainstorm.

WEATHER WISDOM

MAN has always been interested in the weather. He has had to be. Weather has ruled his life throughout the ages, wherever he has wandered on the earth or in the air above. A great many inventions and discoveries have been brought about by man's need to protect himself and his possessions from heat or cold, wind or rain or snow. As his way of living has changed and he has progressed, weather has become more and more important to him.

We read headlines in our newspapers something like these: "School Bus Snowbound," "Heat Wave Brings Death to 7," "Baseball Game Rained Out" and "Farmers Fear Drought."

It is unexpected weather that causes most trouble. If we are able to forecast the weather we can protect ourselves at least partially from its dangers, or gain some of its benefits.

In the middle of the nineteenth century, governments began to set up weather-forecasting services. At first these forecasts were experiments. At that time, not very much was known about the science of meteorology, which is the study of weather. As meteorologists learned more, the forecasts improved, and the services of the weathermen were more in demand. Today, almost every government in the world operates a weather service for its people.

All pictures, Acme
Top, checking a recorder, which indicates approaching storms, for transatlantic flights. Below, preparing weather charts for the newspapers.

This instrument, a triple register, shows the speed of the wind and the amount of sunshine or rain.

In the United States the service is the United States Weather Bureau. When this national weather service was started, in 1870, it was a part of the Signal Corps of the Army. In those days its duties were simply to record facts about the weather at military posts and to give warning of the approach of storms toward the Great Lakes and the seacoasts.

Within a short time floods and river stages were recorded, too. The storm-predicting service was made big enough to cover the entire country. In 1890 the weather service was placed in the Department of Agriculture and organized as the Weather Bureau. Its work was increased to include the forecasting of floods, frost, cold waves, temperature and rainfall. In 1940 it was transferred to the Department of Commerce.

The Meteorological Service of Canada is a division of the Ministry of Transport. It has been a completely established weather service since 1876. Since weather pays very little attention to international boundary lines, the weather services of the two countries work very closely together.

Let us see how weather forecasts are made today. Many people are needed to do this work, not in just one country but in many countries. Not all of these people actually make forecasts. Some have other duties that are necessary to forecasting the weather.

INFORMATION FROM A WIDE AREA MUST BE GATHERED TO MAKE FORECASTS

To forecast, the weatherman must know the current weather conditions all over his own country and sometimes over other countries or over oceans as well. At certain fixed times, hundreds of persons, at different places, read barometers, thermometers and other instruments. They note the type and height of clouds and what the weather is doing. For instance, at 7:30 Eastern Standard Time a person at New York does these duties and at the same moment persons at Chicago, Denver and San Francisco are doing the same thing. The clocks, of course, at these places read respectively 6:30 Central Standard Time, 5:30 Mountain Standard Time and 4:30 Pacific Standard Time.

The weather information that these persons obtain locally is made up into a report. Although the weathermen of the world speak many different languages they can read and understand each other's weather reports, because the reports are in a code which is a sort of "weather language." After coding the weather data, the reports are sent to forecast centers and other weather stations by telegraph, teletype, radio and telephone. For example, reports come to the forecast centers in the United States not only from cities in the United States, but also from

ships at sea and from places in Mexico, the West Indies, Canada and Alaska.

There are many different kinds of weather reports. Some give information about the weather on the surface of the earth. Others give information about what is taking place above the surface, at different heights up to fifteen miles. Instruments tied to balloons are sent up in the air. These instruments are known as radiosondes. With the aid of a small radio, they send weather reports back to the station down below.

THE WEATHER MAP IS A COMPLETE PICTURE OF ALL THE REPORTS

What do all these reports have to do with forecasting the weather? A great deal. The weatherman must know the current weather conditions before he can forecast. Persons at the forecast centers note down the weather reports on maps and charts. When the maps and charts are finished the forecaster has a complete picture of the present weather. He knows what the weather is far above the earth as well as at the surface.

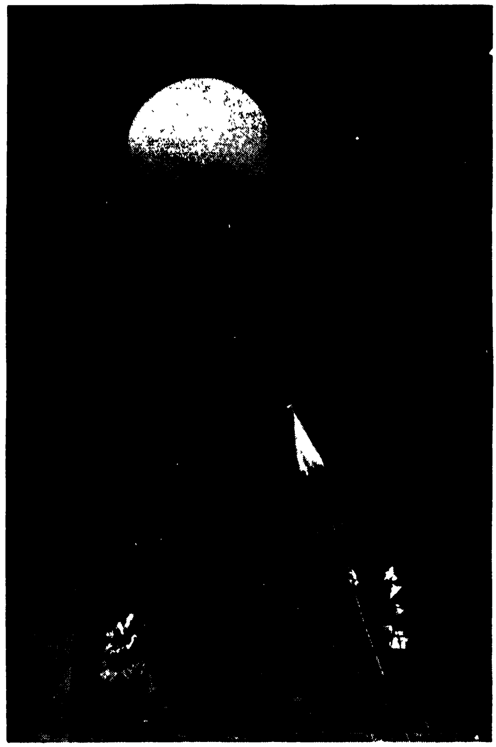
The air above and around us is part of the earth's atmosphere, which is an ocean of air many miles deep. We live at the bottom of this ocean of air. Above our heads the atmosphere is in constant motion.

Air moves in large masses, and it changes according to the surface over which it flows or remains. An air mass will gradually become warm and moist if it stays over a warm-water surface. Air that stays over cold land regions will become cold and dry. That is why some air masses are warm and some are cold, some are moist and some are dry. As these masses of air move across the surface of the earth they bring changes in the weather to the areas they visit.

Storms form along the boundaries between air masses. These boundaries are called "fronts." When a warm air mass moves forward over an area that has earlier been overrun by cold air, the boundary is called a warm front. When cold air moves forward and replaces warm air, the boundary is called a cold front.

In order to foretell the weather, the forecaster must be able to tell how the air masses and fronts will move. And he must foresee the changes in weather they will produce. By studying his maps and charts he is able to do this.

For the most part, the weather in the United States and Canada results from the movement of cold air masses southward from far northern Canada, Alaska and the Pacific Ocean, and the northward movement of the warm air masses from southern regions such as the Gulf of Mexico and the South Atlantic. The warm, moist air moving northward slides up over the cold air coming down from the north. When this happens rains usually occur. The cold air stays down by the ground because it is heavier than the warm air. The warm air is cooled when it is lifted, and the moisture it holds is condensed and forms clouds and rain.



U. S. Weather Bureau, L. E. Johnson
Sending a radiosonde aloft, attached to a balloon, to gather information about the upper air.

At the forecast center several different types of forecasts are made. Some are for the airways and airports, some for the farmers, and others are for the public. These forecasts are sent by teletype and telegraph to the several hundred offices of the Weather Bureau, newspapers and radio stations. At the Weather Bureau offices the local weatherman studies his charts and reports. Then he makes a local forecast for the city or the community that his office serves. If severe weather changes or storms are expected, he issues special warnings.

Before a pilot leaves from an airport, he

U. S. Weather Bureau

Planes drop floating warnings over shipping lanes.

has to check on the present weather along the route he will fly. He asks the weatherman to give him a forecast of what the weather will be when he flies. He needs all this information because weather can be a great hazard to him. Suppose he flies through clouds when the temperature is near or below freezing. Then the front edges of the plane's wings and the propeller blades may become coated with ice. When this happens his plane will lose lifting power and he may crash. He has to have a weather report to set his altimeter, which tells him how high up he is. If this instrument reads incorrectly he may not be able to land safely. Or if a mountain is hidden in the clouds, he may crash into it.

The winds above the surface of the earth can speed the pilot along his way, hold him back or steer him off his course. Therefore, he must have reports on the direction and velocity (speed) of winds at various levels in the atmosphere. The pilot must be able to see a certain distance and be able to see the airport from a certain height above the ground before the control tower will permit him to land. These are but a few of the ways in which weather affects flying.

WARNINGS OF FROST GIVE FRUIT-GROWERS TIME TO PROTECT THEIR ORCHARDS

In the fruit groves of California and Florida, millions of orchard-heaters are lighted on nights when frosts are expected. These heaters protect the fruit from damage by frost. The United States Weather Bureau has special forecasters in Florida and California to make forecasts for the fruit-growers. These forecasters keep close watch on the weather and the development and condition of the crops. When freezing temperature is expected, the fruit-growers are warned in time to light their heaters and protect their orchards from damage. Special forecasts are provided to fruit-growers and farmers in other places. Cranberry-growers are told when frosts are expected. Apple, peach, pear and cherry-growers are told when there will be the right kind of weather for spraying the trees.

Hot, windy weather is especially dangerous in spreading forest fires. The government's Forest Service fights these fires, and the weathermen help the Forest Service. Forecasts of temperature, winds and humidity are made especially for the forests. Forest rangers use this information and place groups of men in danger zones to stop the spread of fires. Such forecasts help to save millions of dollars' worth of timber each year in Canada and the United States.

The coast of the United States along the Gulf of Mexico and the Atlantic Ocean is in danger of hurricanes during August, September and October. These storms are violent and do great damage. The Weather Bureau has special forecasters who watch out for hurricanes. Once a storm is found, the forecasters keep close track of its movement and forecast its direction and speed. By warning shipping and people that a hurricane is coming their way, lives can be saved and damage to property reduced.

"A BLIZZARD IS COMING," AND THE MIDWEST PREPARES TO MEET ITS RIGORS

Very cold air masses coming down from the north during the winter can do great damage in the Midwest. People and livestock may freeze to death when these cold waves occur. Blizzards may precede the cold air and block highways, trap people, cars and busses in drifts, break down electric and telephone wires, and delay trains. Naturally, people living in the Midwest want to be warned when such a cold wave is expected.

The best-known and most widely used forecasts are those we read in our newspapers and hear over the radio and telephone. Daily, millions of people plan their activities according to these forecasts. Restaurants like to know whether the day will be warm or cold when they plan their menus. Office workers take umbrellas or raincoats if rain is expected before the day is over. Housewives plan for their washing if the weatherman says it will be sunny. Planning for family picnics takes the forecast into account. Automobile radiators are drained when below-freezing temperatures are expected. The variety of uses of these forecasts is very great.

By GARRETT DE MOTS.

THE NEXT STORY OF THE EARTH IS ON PAGE 4402.

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A scene from the American polar expedition of 1853. It was led by Dr. Elisha Kane, who also drew this sketch.

THE NORTH POLE MEN

THE first Arctic explorer of whom there is any record was a Greek navigator named Pytheas. About 325 years before the birth of Christ, Pytheas sailed out of what is now the French port of Marseilles, through the straits guarded by the Pillars of Hercules, into the Atlantic Ocean. He explored the coasts of northern Europe, and was, so far as we know, the first navigator to cross the Arctic Circle. Since that voyage, more than twenty-two centuries have passed and thousands of other men have ventured north of the Arctic Circle to the "top of the world." They have gone by sailing ship, steamship, dog sledge, airplane, dirigible and even by submarine under the ice. One ill-fated Polar expedition actually tried to reach the North Pole in a free balloon. But most of the explorers have had to make the last stage of the journey on foot.

The Arctic regions are immense. They are usually considered to include all of the earth's surface that lies within the Arctic Circle, an area of approximately eight million square miles, or roughly three times the area of the United States. An easy way of discussing distances is to use degrees of latitude. The distance from the Equator to the North Pole is ninety degrees of latitude, a quarter of the way around the globe.

One degree of latitude is equal to a little more than sixty-nine miles. It is customary to describe how close the various explorers got to the Pole by giving the degree of latitude they reached. By studying the stars and the sun through instruments called sextants, the explorers were able to tell in terms of latitude where they were and how far they were from the Pole.

If you will open Volume 1, and study the pictures and the article on pages 235 to 239, you will more easily understand the great mystery of the North. Since the earth is tilted on its axis, a small area around the North Pole is turned toward the sun by day and by night for six months of the year (March 21 to September 22), and turned away from the sun for the other six months. The area of continuous day grows larger, following March 21, until, on June 22, all the earth's surface between the North Pole and 66½ degrees North Latitude has daylight for the whole twenty-four hours. The line marking off this area we call the Arctic Circle. The region inside the Arctic Circle we call the Arctic, or North Polar, region.

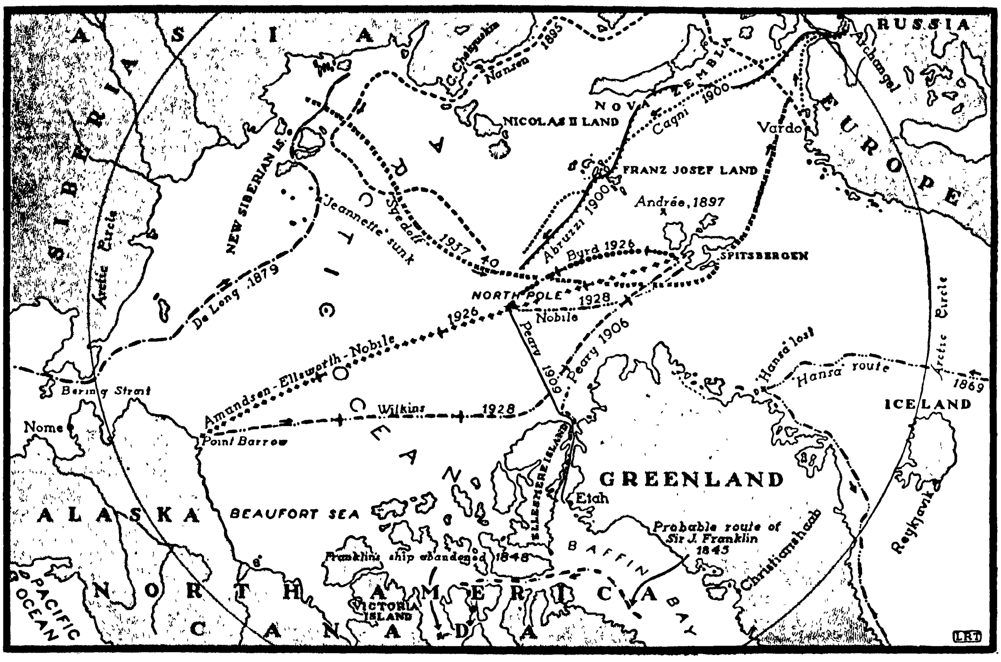
Most of the Arctic region is occupied by the Arctic Ocean, which in some places is extremely deep. It is covered with thick ice most of the time, either solid ice or pack ice that drifts. There is not much land north of the Arctic Circle. Greenland and northern Canada extend up above the circle for some distance, and small slices of Norway, Sweden, Finland, Siberia (and a bit of northwest Russia) and Alaska lie within the circle. However, except for a few snow-covered islands, most of them small and uninhabited, there is nothing in the vast interior of the Arctic but ocean. Here, during the long dark winter months, the temperature stays down around fifty degrees below zero, and great storms arise whose intensity is so tremendous that they affect the weather of Europe and America. Only the Eskimos and the hardiest Arctic animals, such as the polar bear and the caribou and the musk-ox can survive such winters.

Beneath the blanket of ice, there is salt water, in some places thousands of feet deep; and it has been estimated that this water has a temperature of about twenty-eight degrees Fahrenheit. That is not so very cold, though it is below the freezing point of fresh water. Some scientists believe that a considerable amount of animal and plant life may thrive in these distant waters, particularly small shellfish and other fish on which seals and whales live. This is not known for certain.

The people dwelling within the Arctic Circle are mostly Eskimos, whom we describe in another chapter. Friendly Eskimos have been of great service to explorers from Europe and America.

This great deep-water area, the Arctic Ocean, has two doorways through which ships can enter. One is the Bering Strait, between Siberia and Alaska. It leads from the North Pacific Ocean into the Arctic Ocean. The other is the much broader North Atlantic doorway which gives entrance to the Arctic Ocean between Labrador and Norway. It has been through this entrance that most of the Arctic explorations have sailed.

Why should anyone want to go to the Arctic? There must be some compelling reason that has made men willing to risk their lives and fortunes in such a dangerous and barren part of the world. Just why several thousands of men—the captains and their crews alike—have chosen to sail away from the comforts and safety of civilization



Area inside the Arctic Circle and the routes of some of the chief expeditions in search of the North Pole.

and endure the hardships of the dim, mysterious, frozen Arctic is an interesting question. Some, like Pytheas, went there out of pure curiosity. Others have been driven north by storms or arrived there by accident because of bad navigation. A few expeditions ventured to the Far North in the search for gold. Still other men sailed into the Arctic in search of whales or furs, or to find inhabitants with whom they could trade. Most of those, however, who braved the northern sea gates were explorers; men of science or adventure who gladly left their homes in order to discover and chart the unknown. It is noteworthy that the majority of these men—whether they were the leaders or the crew members who went, or the stay-at-home adventurers who provided the money for the expeditions—had practically no idea of making money out of these ventures.

Dr. Fridtjof Nansen, the Norwegian explorer.

Leaving out the whaling ships and the storm-driven fishing ships, most of the men who have sailed into the Far North were intent on one or more of the following things: to reach the North Pole itself; to find a northwest passage to the Orient; to find a northeast passage to the Orient; or to explore the Arctic area generally and to make scientific observations there.

The discovery of the North Pole itself has always appealed to the imagination of the world more than any of the other aims of Arctic exploration. The men who have risked or given their lives and fortunes trying to reach the Pole have been considered the most romantic figures of Arctic exploration and have received the greatest public acclaim.

It was not until 1909, or 2,234 years after Pytheas made his first voyage north, that the North Pole was finally discovered by the American, Admiral Robert E. Peary. Since then, the Pole has been reached several times, but most of these successful attempts were made with relative ease in airplanes.

Just before the start of the second World War, the world's interest in the Far North shifted to the possibility of its use as a short

Dr. Nansen's ship, the Fram.

Norwegian official photos

sea route to the Orient from the Western Hemisphere, as a possible source of mineral wealth and, more particularly, as the shortest air route between parts of Europe, America and Asia. We shall describe these more recent developments later. First, however, let us consider the almost unbelievable skill and bravery of the long line of brave men who, down the centuries, have fought to conquer the cold fortress of the North and to lay bare its secrets. No more heroic record exists in all the valiant history of exploration and adventure.

HOW THE WHITE SEA WAS DISCOVERED BY AN EARLY EXPLORER IN THE ARCTIC REGIONS

After the voyages of Pytheas in 325 B.C. there is a period of about 1,150 years from which no record of Arctic exploration has come down to us. About 825 A.D. an Irish monk named Dicuil wrote that other Irish monks had discovered the Faroe Islands and the island of Iceland. The first detailed account of an actual Arctic exploration was written by King Alfred the Great about the voyages of Ottar (or Othere), a Norwegian, who had described his experiences to King Alfred. About 870 Ottar sailed eastward from North Cape along the Murman Coast and discovered the White Sea. In so doing, he discovered a route made famous more than a thousand years later by the British and American convoys taking supplies to Russia during the second World War. He told King Alfred that he "chiefly went thither, in addition to seeing the country, on account of the walruses and their noble teeth."

LONG BEFORE COLUMBUS, THE VIKINGS DISCOVERED GREENLAND AND AMERICA

During the 700-year period between 800 and 1500, the Norsemen (or, as they are usually called, the Vikings) made many famous voyages into the North, and left a record of them that has come down to us in their sagas, or tales. Among the great Norse navigators were Eric the Red, who discovered Greenland in 982 A.D.; King Harald Haardraade (Hard-Ruler), who was an Arctic explorer; and Leif Ericson, who discovered North America in 1000 A.D.—or almost 500 years before Columbus made his first voyage of discovery.

The ancient Norsemen, however, were not "North Pole men." That is, they were not concerned with trying to find the Pole. As a matter of fact, they had probably never even heard of the Pole. The Norse were chiefly interested in catching fish, whales and walruses. In the pursuit of these, they visited and explored the northern seas from Novaya Zemlya on the east to Labrador, Newfoundland and Nova Scotia on the west.

The Norse Vikings were also the first sailors we know of who deliberately left the shelter and safety of the coasts and boldly sailed out of sight of land across the open sea. They were the first to sail across the North Atlantic. They were fearless pioneers of ocean navigation and taught their skill to the rest of Europe.

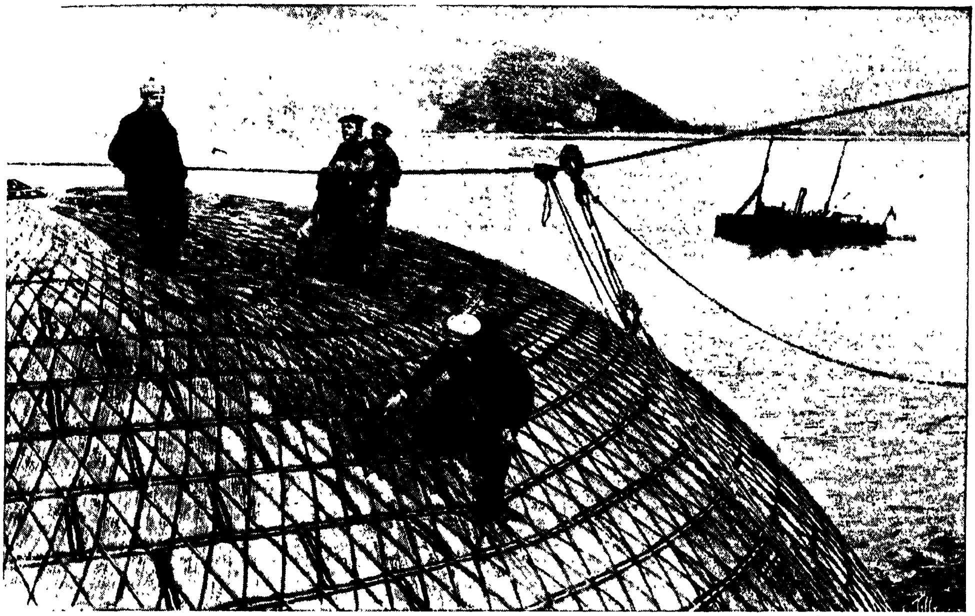
Columbus failed to reach China by sailing westward from Europe. During the sixteenth century, it became clear to all educated Europeans that Columbus' idea was correct, but that the continent of America lay in the sea-path to China. The vastness of the continent was not guessed, however, and so men tried to sail around it on the north and on the south. Many tried to cross the interior by sail and canoe and on foot.

SEEKING A NORTHWEST PASSAGE, EARLY NAVIGATORS EXPLORED THE ARCTIC

During the sixteenth, seventeenth and eighteenth centuries there were numerous voyages into the North undertaken by English, Dutch and Portuguese navigators in an effort to find a short route to the rich markets of Cathay, or China. These men were not "North Pole men" either, but their voyages were of great value to the North Pole men; for each one contributed something of experience and Arctic lore to those navigators of the nineteenth century who began the long effort to find the Pole. These early Arctic navigators included such great men as John and Sebastian Cabot, Rut, Centurione, Sir Hugh Willoughby, Richard Chancellor, Borough, William Baffin, Pet, Corte-Real, Martin Frobisher, John Davis, Willem Barents, Henry Hudson, Vitus Bering and Captain James Cook. They are among the great navigators and sailors of all time, and the Arctic maps are studded with their names. We tell the story of the attempt to reach a northern passage to Asia on page 2977.

A DUTCHMAN, WILLEM BARENTS, FIRST LED A TRIP TO GAIN KNOWLEDGE OF THE NORTH

The first recorded expedition to the Arctic regions which set out for the purpose of enlarging our knowledge of the North was made in 1594-95. It was a Dutch venture, led by Willem Barents (or Barentz). He took a map-maker with him, one Gerrit Veer, who made at least one picture-map showing whales and seals in the cold seas



Bettmann Archive

Many ways of reaching the North Pole have been tried by explorers. A flight by balloon was attempted by a Swedish aeronaut, Salomon Andrée (1843-97). The attempt met with failure, however, and Dr. Andrée lost his life.

to be found well inside the Arctic Circle.

In 1773 the British Government and the Royal Society became interested in fostering Arctic exploration with the idea of gathering scientific knowledge of all sorts. They sent out two ships under the command of Captain J. C. Phipps. His ships were finally stopped by a sheet of ice twenty-four feet thick, off the northwest coast of Spitsbergen. The popular interest in this voyage for scientific discovery must have been great, for when Phipps returned to England in September, even the great Doctor Samuel Johnson took notice of his experience. Dr. Johnson said that it was "conjectured that our former navigators have kept too near land, and so have found the sea frozen far north, because the land hinders the free motion of the tide; but in the wide ocean, where the waters tumble at their full convenience, it is imagined that the frost does not take effect."

Dr. Johnson was right. In the unknown and fog-wrapped Arctic, only the ancient Norse sailors had had the courage and skill to navigate out of sight of land.

In 1818 the British Government passed a measure to promote polar exploration, offering an award of £20,000 to anyone who could find a northwest passage to the Orient, and £5,000 to anyone who could reach 89° North Latitude—that is, to anyone who could get within one degree (69 miles) of the Pole.

Following these generous offers, the number of Arctic expeditions increased greatly, and many of the bays, islands and inlets in the Arctic regions were named for men who explored the North between 1820 and 1850. They included such great captains as Sir John Barrow, Lieutenant (later Rear Admiral) William Edward Parry, the Russian Count Fëdor Petrovich Lütke, Clavering, Sir Edward Sabine, the Danish Graah, Sir John Ross and his nephew Sir James Clark Ross, and many others.

One of the greatest of these men was Captain William Edward Parry, whose expedition of 1819 is one of the finest voyages of discovery in Arctic history. He had sailed first with Sir John Ross. He made three voyages under his own command. In 1827 he made a supreme effort to reach the Pole. He sailed from the island of Spitsbergen but gave up after he had reached 82° 45′, for he found that the ice was breaking up and drifting south as pack ice faster than he could travel north over it with dog teams. He had reached a point farther north than any other European had gone.

One of the most tragic stories in Arctic exploration is that of the last expedition of Sir John Franklin. In 1845, he set out in two vessels, the Erebus and the Terror, to find a northwest passage, and was never seen again. When, after two years, he had not returned, great anxiety began to be felt and for years thereafter a long series of rescue expeditions set out to look for him or to determine the fate of his ships. Some of these voyages were paid for by his wife. All together, these many efforts to find Franklin resulted in the discovery and mapping of 7,000 miles of coastline, the mapping of several lands and islands, and the winning of a great deal of scientific knowledge.

The uncertain fate of Franklin and his men aroused interest everywhere. The American people, who up till then had shown little or no curiosity in Arctic exploration, suddenly became interested in it, and their efforts had much to do with the great advances made in the Arctic after 1850. The first American polar expedition was financed and organized by a man named Grinnell of New York, who, in 1850, sent two ships north to aid in the search for Franklin. These were commanded by Lieutenants De Haven and Griffith, who took with them Dr. Elisha Kent Kane. This first American expedition had an uneventful voyage and returned the same year, having found no sign of Franklin. Its most valuable result was to make an Arctic enthusiast out of Kane. In 1853, Kane led another expedition; he sailed in the Advance up Baffin Bay to investigate Smith Sound, the most northerly outlet of Baffin Bay. In the course of this voyage, which lasted two years, Kane discovered the great Humboldt Glacier, which has a sea face forty-five miles long. This expedition made many trips by sledge over the ice and collected valuable scientific observations.

Bettmann Archive

Mr. and Mrs. Peary in Greenland in 1891.

Kane was followed by other Americans. In 1860 the American Charles Francis Hall discovered the remains of a stone house that had been built by Sir Martin Frobisher on Countess of Warwick Island in 1578, during the reign of Queen Elizabeth. Hall made a second expedition. It lasted from 1864 to 1869; and during this voyage Hall discovered the fate of the Franklin survivors who had fled from their crushed ship to the south coast of King William Island. Here an Eskimo told Hall how they died, and led him to the place where some of them were buried. In his last expedition, Hall took his ship, the Polaris, up to Smith Sound, which Kane had tried to explore. He went into winter quarters in a bay called Thank God Harbour at 82° North Latitude; and he died there in the winter of 1871.

Meanwhile, many efforts were made to find a navigable sea route to the Orient either east or west across the Arctic Ocean. The first ship to accomplish the northeast route was commanded by a Swedish scientist, Baron Nils Adolf Erik Nordenskjöld, in 1878.

The Northeast Passage has since been made many times, and today the Russians have a regular route eastward across the Arctic which they keep open with specially built ice-breakers.

The Northwest Passage—that is, a sea route westward from the Atlantic through the Arctic and into the Pacific, which men had long sought—was not successfully navigated until 1906 when Captain Roald Amundsen, a Norwegian, made it in the Gjoa. He had set out in 1901 in his small ship, which had an auxiliary gasoline engine and carried a crew of only six men, to visit the North Magnetic Pole and make studies of magnetism. After two years of making observations at the magnetic pole and in exploring and mapping the coasts of Victoria Land, he turned his little vessel westward and finally, after two more years of slow and perilous sailing through the Arctic ice-fields, he won through to Bering Strait and the Pacific Ocean. His was the first ship to sail from the Atlantic to the Pacific north of Patagonia. (Patagonia is the southern tip of South America.) The British Captain McClure had actually made the voyage in the opposite direction some years before, but he had to abandon his ship

COMMANDER PEARY EXPLORES THE ARCTIC

Culver Service
Commander Peary's ship, the Roosevelt. This was the first ship built in the United States for Arctic exploration.

Culver Service
Peary on the deck of the Roosevelt, with some of his Eskimo dogs. On earlier trips he had shown Greenland to be a large island.

Culver Service
One of Peary's earlier ships, the Falcon, at Cape York in Greenland.

American Museum of Natural History
One of Peary's dog-sleds, with which, on April 6, 1909, he finally reached the North Pole. He returned safely.

and make part of his journey on foot until he was picked up by a rescue ship which carried him back to England.

The feat of Amundsen in forcing a ship through the Northwest Passage was repeated only twice up to the second World War. In each case the difficult trips were made by servants of the Hudson's Bay Company.

A GREAT PERIOD OF ARCTIC EXPLORATION LED TO DISCOVERY OF THE NORTH POLE

About 1875 there began a period of intense activity in Arctic exploration. It reached its peak some thirty-five years later when, in 1909, Admiral Robert E. Peary finally reached the Pole. This crowning event, together with the outbreak of World War I in Europe in 1914, brought this great period of exploration to a close. Men from every walk of life, from every maritime country, and of great and small fortune, had joined in the expeditions that were sent into the Arctic during this period. So numerous are the names of these men that we have not space to mention all of them and do justice to their accomplishments. The start of this period of intense activity was caused by the success of the British expedition of 1875-76 under the leadership of Captain George Strong Nares (later Sir George). A party from this expedition, in the spring of 1876, made a dash for the Pole over the ice and got as far as 83° 10′ 26″, the point farthest north ever reached up to that date. At about the same time (1875-76) Sir Allen William Young in his yacht Pandora made two unsuccessful attempts to find a northwest passage.

In 1878 the Dutch, under the command of Koolemans Beynen and De Bruyne, made a series of polar expeditions; and the Dutch continued to send expeditions for many years. In 1879 and 1880, Sir Henry Gore-Booth and Captain Albert Hastings Markham (later Sir Albert), of the British Royal Navy, made a voyage into the Kara and Barents seas and brought back a great natural-history collection.

THE STRANGE ADVENTURE OF AN EXPLORING PARTY WHOSE SHIP WAS CRUSHED BY ICE

The year 1880 marked the famous expedition of another Englishman, Benjamin Leigh Smith. He was a rich man interested in polar exploration, and he had built a steam yacht especially suitable for Arctic conditions. In this ship, the Eira, he discovered and partially explored Alexandra Land, an island west of Franz Josef Land. The following year his ship was crushed by the ice and sank almost immediately. Fortunately the crew had just transferred a great deal of food and other supplies to shore and had built huts. In these shelters the party survived the winter of 1881-82, and in the following June they made a long and perilous trip south in small boats and were eventually picked up off the coast of Novaya Zemlya by a rescue ship sent out by Sir Allen Young.

It was in 1878 that Nordenskjöld made his famous voyage from Sweden eastward to the Pacific Ocean in the Vega. This ship, after more than a year of close escapes and good handling, sailed into Yokohama, Japan, without the loss of a single man or damage to the ship. Thus was the Northeast Passage finally forced, 326 years after the first disastrous attempt made by Sir Hugh Willoughby in 1553.

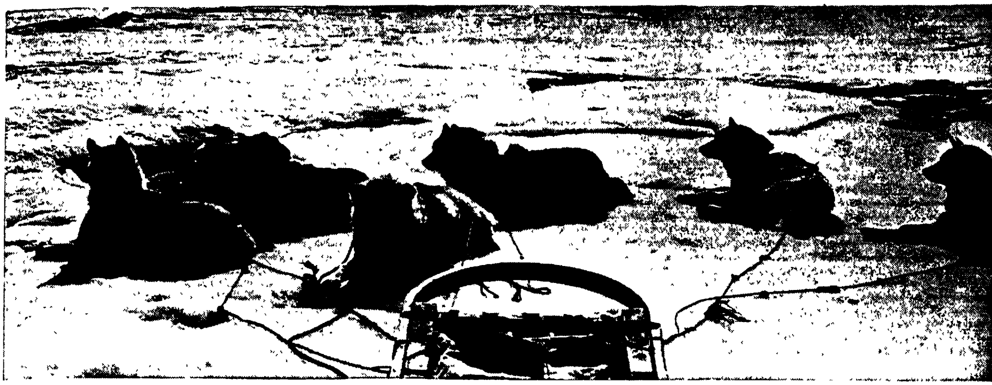
HOW FOUR AMERICAN EXPLORERS OBTAINED THEIR FOOD IN THE FROZEN NORTH

Lieutenant Frederick Schwatka, of the United States Army, and three companions set out with the object of discovering more of the fate of the ill-fated Franklin expedition of 1845. While the Schwatka expedition did make some discoveries about Franklin's fate, the most interesting thing accomplished was that these four men, who took only one month's provisions with them, were able to sustain themselves with game that they shot. On the journey out and back, through the intensely cold Hudson Bay country, they killed a total of 522 caribou with which they fed themselves, their Eskimo guides and their dogs. At times the temperature became as cold as seventy degrees below zero.

THE TRAGIC FATE OF THE LEADER AND MEN OF THE BENNETT EXPLORATION VOYAGE

Another notable expedition of 1879 was the Bennett expedition under Lieutenant (afterward Captain) George Washington De Long of the United States Navy. This was a national undertaking under a special act of Congress. George Gordon Bennett, owner of the newspaper THE NEW YORK HERALD, bought the ship Pandora from Sir Allen Young and rechristened it the Jeannette. With a Navy crew aboard, under De Long, the Jeannette sailed from San Francisco in July of 1879, headed for Bering Strait. It was last seen near Wrangel Island early in September. It had been provisioned for three years, but when no word had come after almost two years, rescue steamers were sent out in search. These gained no information; but later news of the ship's fate came

ESKIMO DOGS AND ARCTIC CLOTHING



American Museum of Natural History

Here an explorer shows us some of his equipment. Donald B. MacMillan, American scientist, has explored many parts of the Arctic regions. Above, we see some of his Eskimo dogs in Greenland. In the lower pictures, Donald MacMillan wears the heavy fur clothing, the high boots and cap necessary for withstanding the terrible cold.

Culver Service
Vilhjalmur Stefánsson lived as one of the Eskimos.

from Siberia. After being frozen in the ice for twenty-two months, the Jeannette was crushed by the ice near New Siberia Island and sank. Her leader, De Long, and many of his crew died of starvation and cold, some others were drowned, and a very few made their way to settlements in Siberia and eventually reached home.

THE WRECKAGE OF A SHIP SHOWED HOW THE ARCTIC CURRENT PASSES THE NORTH POLE

Meanwhile, the wreckage of the Jeannette provided a very valuable and remarkable record for the scientific annals of the Arctic. Bits of the ship and its stores were carried by the Arctic current straight toward the North Pole. Passing the Pole about fifty miles to the east, the wreckage continued in a southerly direction, passed into the Greenland Sea between Greenland and Spitsbergen, through Denmark Straits between Greenland and Iceland, and finally was swept down the coast of North America by the Labrador Current. This long journey demonstrated how the so-called Polar Drift works, and showed that the waters of the Pacific might easily circulate through Bering Strait, around the Arctic and down into the North Atlantic.

The idea of establishing a series of weather stations around the Pole, in order to obtain weather information and collect data on the earth's magnetism, was first suggested by a German, Lieutenant Karl Weyprecht, who had been one of the discoverers of Franz Josef Land. He died before this plan was actually carried out, but by 1882 ten nations had made arrangements to take weather and magnetic data for one year at various points around the Arctic. The whole scheme was successfully accomplished except for the part assigned to the Dutch, whose ship came to grief and was unable to reach her station. The countries taking part in this scientific project were the United States, Great Britain, Sweden, Norway, Holland, Russia, Finland, Germany, Denmark and Austria.

DANGERS AND HARDSHIPS WHICH MILITARY SCIENTISTS MET NEAR THE NORTH POLE

The American share in this plan was carried out by two expeditions, one to Point Barrow under Lieutenant P. H. Ray, and the other, under Lieutenant (later Major General) Adolphus W. Greely, to Lady Franklin Bay only a little more than eight degrees from the North Pole. Greely and his men, who were all members of the United States Army, made some of the most successful scientific observations taken in the project. In addition, they made many exploratory trips. They were to have been sent relief after one year, but the relief ships never arrived that first year, or the next, and it was not until the summer of 1884—three years after Greely had set out—that a relief ship finally reached his party.

By this time only Greely and a few companions remained alive, but they had saved intact their scientific findings, their instruments and their collections of specimens. The expedition was one of the most remarkable in Arctic history. The men suffered almost all the rigors and misfortunes that can happen in the Arctic, and still they brought back the information and the results they had set out to get.

Dr. Fridtjof Nansen was one of the greatest of the Arctic explorers. In the 1880's he and the American naval officer Robert Edwin Peary had both made extensive surveys of Greenland, the interior of which is covered with a great mass of ice rising to heights as great as 9,000 feet. In the early 1890's, Nansen decided to try to follow the Arctic drift, which he suspected

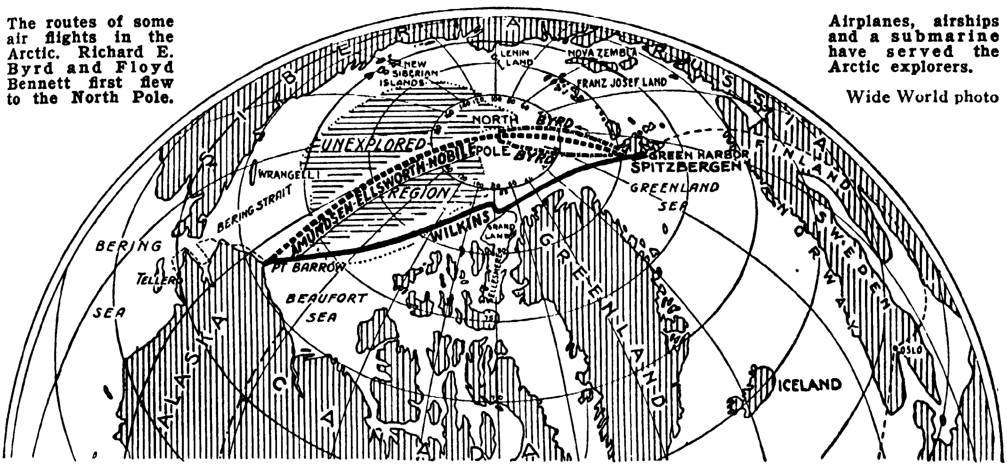
flowed from east to west across the Pole and then down into the Atlantic. He built a specially designed ship, the Fram, which would not be crushed when the ice closed in on it, but would lift up and ride on top of the opposing ice masses which would tend to pass under the ship instead of crushing it. His design proved to be correct for this purpose. In July, 1893, he set out from Christiania (now Oslo). He steamed and sailed north and east until, opposite the New Siberia Islands, where the Jeannette had been crushed, he met the ice closing in. Instead of being crushed, his ship was forced up on top of the ice mass. Winter set in. Then for the next thirty-five months the Fram was carried along with the ice on its westward journey.

The ship drifted on the ice northwestwardly until it reached 84° North Latitude. At that point Nansen and a companion, Lieutenant Frederic Hjalmar Johansen, left the ship in the command of its captain, Otto Neumann Sverdrup. Nansen and Johansen made their way by dog-team and sledge toward the Pole. They had many amazing adventures and endured terrible hardships, but they pushed ahead until they got to 86° 14′, the farthest north any man had gone. Then winter was once more descending, and they had to turn back. After further adventures—staring death in the face on many a day—they finally reached Franz Josef Land, in June, 1896, where they met members of another exploring group, the British Jackson-Harmsworth expedition. The ship of that expedition, the Windward, carried Nansen and Johansen back to civilization, after their hazardous journey.

Meanwhile the Fram, on its drifting ice, had been carried by currents and winds to 85° 57′, the farthest north any ship had gone. Nansen and Johansen reached Tromsö but a few days after Sverdrup brought the Fram to the same port. None in the expedition had been lost and the results of their journey were of great importance.

We have spoken of the Jackson-Harmsworth expedition of 1894. The Duke of Abruzzi, a royal prince of the Italian ruling house, later succeeded in making the greatest advance toward the Pole of anyone up to his time. He and his party reached 86° 33′ in 1900.

The routes of some air flights in the Arctic. Richard E. Byrd and Floyd Bennett first flew to the North Pole.



Airplanes, airships and a submarine have served the Arctic explorers.

Wide World photo

Salomon August Andrée, a Swedish balloonist, believed that the Pole could be reached in a balloon by taking advantage of the prevailing winds and by guiding the balloon's direction with the aid of long ropes trailing on the ice. In July, 1897, he went up in a large balloon from Dane's Island, north of Spitsbergen. With him were two companions and a quantity of food and supplies. Seven and a half hours after his take-off he threw out a buoy containing a message stating that he had reached 82° 25′ North Latitude, and that his balloon was moving toward the northeast at a height of 800 feet. That was the last that was heard of Andrée for thirty-three years. In 1930 his body and that of one companion were found frozen in the ice of White Island, with Andrée's diary telling the tragic story of their last days.

Around the beginning of the twentieth century, several other explorers set out for the "top of the world." Admiral Makaroff tried unsuccessfully to get to the Pole in

a specially designed ice-breaker. Captain Otto Sverdrup, who had sailed with Nansen on two voyages, refitted the old Fram and explored a great deal of unknown territory. Baron Eduard von Toll found the fossil remains of mammoths and other long-extinct animals on the New Siberia Islands. We have already told of Roald Amundsen's successful navigation of the Northwest Passage between 1903 and 1906. There followed, in 1905, the tragic Danish expedition under the command of Ludvig Mylius-Erichsen. Both the accomplishments and the sufferings of the members of this expedition were unusual, and their fate was known only from the written reports and descriptions which the relief expedition found by their frozen bodies.

And now we come to the great climax of our story, the reaching of the Pole by Admiral Robert Edwin Peary, United States Navy. The main thing that led to Peary's success was his unending effort. Neither the misfortunes of other explorers nor his own setbacks ever discouraged him from his goal. He was born in Pennsylvania in 1856 and in due course joined the United States Navy as an engineering officer. His first Arctic journey was made into Greenland in 1891. From then on, and mostly with money which he raised by lecturing, he made many trips to the Arctic and probably learned more about the Far North and how to survive its hardships than any man before or since. In 1899 he lost most of his toes when his feet were frozen at Fort Conger. His own account of how his companions, who were all affected by lack of food and cold, got him to his ship, some 250 miles away, is typical of the experiences that nearly all Arctic explorers have undergone.

Commander Richard E. Byrd at the time of his North Pole flight.
Keystone View

Floyd Bennett, who flew with Byrd in the first air trip to the North Pole.
Culver Service

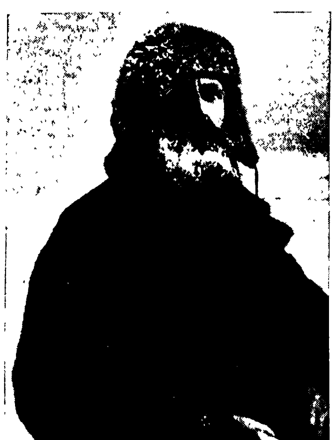
"Lashed to a sledge," he writes, "my feet wrapped in a musk-ox skin, I was carried on a journey made in 11 marches, of from 12 to 18 hours each, bumping and pounding over the broken ice of the Arctic Sea. The mean minimum daily temperature was 53½ degrees below zero; the temperature of the day we reached the ship was 65 degrees below zero. . . ."

Peary made eight great journeys to the North, and beat all previous records, before winning the goal. He demonstrated (as Vilhjalmur Stefansson also showed) that a white man may live in the Arctic if he is willing to learn how from the Eskimos, and adapt himself to the conditions there. Twice Peary was accompanied by his devoted wife, who was the first white woman to winter in the Arctic. Their daughter, Marie Peary, was born there in 1893.

Sir Alfred Harmsworth (later Lord Northcliffe), patron of the Jackson-Harmsworth expedition and owner of the ship Windward which had rescued Nansen and Johansen,

gave the Windward to Peary for one of his trips.

Finally, in 1908, Peary set out in the middle of February in his ship, the Roosevelt (named in honor of President Theodore Roosevelt), with one of the finest Arctic crews ever assembled. The master of the ship was the famous Captain Robert A. Bartlett, probably the greatest ice master in Arctic history. The crew consisted of



Professor Otto Schmidt, Russian explorer, flew to the North Pole in 1937.

7 white men, 17 Eskimos and 1 Negro. They had 19 sledges and 133 dogs. The entire journey was carried out according to a careful plan, with naval precision. Finally, on April 6, 1909, accompanied only by Matthew A. Henson, Negro friend and devoted servant, and four Eskimos, Peary reached 90° North Latitude, the Pole. A sounding of the ocean at the Pole, taken through the ice, went down 1,500 fathoms deep without touching bottom. Peary's success was due to his twenty-three years of Arctic experience and to his thorough knowledge of Eskimos and dogs.

During the next fifteen years, the chief Arctic explorations were carried on by a Canadian, Vilhjalmur Stefansson, and an American, Donald B. MacMillan. Stefansson was notable for his ability to live as comfortably in the Arctic as the Eskimos, whose habits, dress, food and languages he adopted. During one of his expeditions he discovered a tribe of white Eskimos. MacMillan led a valuable expedition, in 1911, for the National Geographic Society During expeditions in 1923, 1925 and 1927 he kept in touch with civilization by radio. Meanwhile, in 1925, Roald Amundsen made the first attempt to reach the Pole by airplane, but this was a failure.

The Pole was first reached by airplane on May 9, 1926, when Commander Richard E. Byrd and Floyd Bennett made a round trip of over 1,500 miles from Spitsbergen to the Pole and back. Of this historic flight, Byrd has said: "Peary's trip to the North Pole and back kept him out of touch with civilization for more than 400 days. Bennett and I left civilization early one morning, visited the north apex of the earth, and returned on the afternoon of the same day."

Two days after this flight, the Amundsen-Ellsworth-Nobile expedition set out in the dirigible Norge with seventeen men aboard, circled the Pole at the height of 300 feet, and announced their position by wireless.

The Russian scientist Papanin and his dog at the North Pole.
Photos, Sovfoto

They finally landed in Alaska after a trip of seventy-one hours.

In 1928, the Australian Arctic explorer, Captain George Hubert Wilkins, and his pilot, Lieutenant C. B. Eielson, flew from Alaska to Spitsbergen, a distance of some 2,200 miles, in twenty hours and saw no land in any of the portion of the Arctic Ocean they covered. They were followed,

Sovfoto

M. Vodopianov, Russian explorer, who flew with Professor Schmidt to the North Pole in 1937, and set up camp.

in May of 1928, by the near-tragic polar cruise of the airship Italia, commanded by the Italian general, Umberto Nobile. The balloon fell to the ice near Northeast Land, and it was almost two months before rescuers, using radio, ice-breakers and airplanes, were able to rescue Nobile and most of his crew. In 1931, Lincoln Ellsworth and Sir George H. Wilkins, who had previously flown over the Pole, made an Arctic voyage in the submarine Nautilus under the polar ice-fields.

In 1937 the Russians began to study the weather and magnetic conditions near the Pole. Two Russian explorers, Vodopianov and Otto Yulevitch Schmidt, flew to the North Pole and set up a camp and a radio station. Russia thereupon claimed possession of the North Pole and sent out a party under the scientist Papanin to relieve the first two. Papanin and his party were prepared to remain a year at the Pole, and for a while they sent out regular weather reports. Finally, however, a storm in February, 1938, split the ice cap where they were encamped and the men were rescued only with great difficulty. In the meantime, the Soviet Government has developed the Northeast Passage in the Arctic, along the Siberian coast, and with the aid of ice-breakers, has been able to get ships through to the Pacific Ocean for three months of the year. The route is a closely guarded Russian secret. No navigation charts have been issued, and so far ships of no other nation have been allowed to use the passage. In addition, the Russians have set up a series of weather-reporting stations in the Arctic. In 1940, there were sixty-four of these stations in operation. The entire Arctic activities are secret and under strict military control of the Russian Army and Navy. By 1939 the Russians were able to announce that their Arctic sovereignty decree of 1926 was now in effect. In the 1926 decree the Russians had announced: "All Arctic territories between Longitude 32 degrees . . . East and 168 degrees West already discovered, or to be discovered in the future, are territories of the Soviet Union." The effect of this action may mean that future polar exploration in that great unknown area will be carried on only by Russian explorers.

Meanwhile, in order to get coal for her shipping in the Great North Sea Route, as they call it, the Russians have a concession to mine coal and other minerals on Spitsbergen. From this island they have mined in recent years about half a million tons of coal annually. In addition to coal, this large island contains good deposits of asbestos, copper, gypsum, iron, zinc, phosphate

and oil—important materials for Russia.

The Soviet Union, however, is not the only country now exploiting the riches of the Arctic. Canada and Alaska are both extremely rich in minerals along the Arctic belt, and the development of these natural resources on a large scale only awaits the time when greater need and lesser transportation costs make it profitable to mine them.

The newest value of the Arctic to the world lies in the fact that the shortest air routes between many parts of the Northern Hemisphere lie across the Arctic.

The North Pole men of the future, then, will probably be the miners who will tap the Arctic mineral wealth and the aviators who will pilot great air liners across the "top of the world." You may be interested in reading now Men of The Northen Sea Gates, beginning on page 2977. There you will find the wonderful and terrible story of the search for the northern sea route. To reach the Far East and the Pacific Ocean, men sought, and finally found, the Northeast and the Northwest passages.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 4427.

SOME OF THE NORTH POLE MEN

Pytheas (late 4th century B.C.), Greek navigator and geographer; explored coasts of western Europe, and was first Greek to form a correct theory about the tides and their relation to the moon.

Eric the Red (10th century), Norwegian navigator; discovered Greenland, which he named, in 982, and explored it for next three years, planting a colony there in 986.

Leif Ericson, son of Eric the Red. About 1000 he sailed westward and discovered land he named Vinland, or Vineland. Vinland was certainly the coast of North America—Labrador, Newfoundland or New England.

Harold III, called Haardraade (Hard-Ruler) (1015-66), king of Norway and explorer; sailed with large fleet to join in an invasion of England in 1066, and was slain at Battle of Stamford Bridge.

Sir John Barrow (1764-1848), English traveler and diplomat; founder of the Royal Geographical Society, in 1830, and secretary of the Admiralty for 40 years, during which time he did much to promote Arctic exploration.

Sir John Ross (1777-1856), Scottish explorer; made expeditions in search of Northwest Passage in 1818 and in 1829-33, surveying Boothia Peninsula, King Wilhelm Land and Gulf of Boothia; undertook third voyage in search of Franklin.

Sir John Franklin (1786-1847), English naval officer and explorer; served in Napoleonic Wars. Led Arctic expeditions in 1818, 1819-22, 1825-27 and 1845-47. He and all his party were lost on last voyage, and their fate remained unknown for the next 20 years.

Sir Edward Sabine (1788-1883), English scientist and explorer; astronomer to expeditions of Sir John Ross, 1818, and of Parry, 1819-20, in search of Northwest Passage. Conducted experiments to determine the shape of the earth and made important contributions to man's knowledge of the earth's magnetism.

Sir William Edward Parry (1790-1855), English explorer; made three attempts to find Northwest Passage between 1819 and 1825; tried to reach North Pole by sledge boats from Spitsbergen in 1827, and reached latitude 82° 45′.

Count Fëdor Petrovich Lütke (1797-1882), Russian naval officer and navigator; explored coasts of Kamchatka and Novaya Zemlya, 1821-25; commanded voyage around the world, 1826-28, exploring coasts of Siberia and Alaska.

Sir James Clark Ross (1800-62), Scottish explorer; made four Arctic voyages under Parry between 1819 and 1827. With his uncle, Sir John Ross, determined position of North Magnetic Pole, 1831. Made voyage in search of Franklin, 1848-49. Commanded Antarctic expedition in 1839-43, and Ross Sea, Ross Island and other parts of Antarctica are named for him.

Elisha Kent Kane (1820-57), American naval surgeon and explorer; senior medical officer with First Grinnell Expedition, searching Arctic for Franklin, 1850-51. Led Second Grinnell Expedition, 1853-55, and discovered new territory.

Charles Francis Hall (1821-71), American explorer. Led expeditions to Arctic in 1860-62, 1864-69 and 1871. On the second voyage, learned the fate of the Franklin party from Eskimos. Hall died in the Arctic.

Sir Allen William Young (1827-1915), English mariner. On polar expeditions in 1857-59, 1860 and 1875; rescued the explorer Benjamin Leigh Smith and his party on coast of Novaya Zemlya in 1882.

Sir George Strong Nares (1831-1915), English naval officer. In 1872-74 he explored the Antarctic on first steamship, the Challenger, to cross Antarctic Circle; on Arctic expedition in 1875-76, which reached 83° 10′ 26″ North Latitude, the farthest north to that time.

Baron Nils Adolf Erik Nordenskjöld (1832-1901), Swedish geologist and explorer, born in Helsingfors, Finland. In 1868 he led expedition that reached 81° 42′ North Latitude, the farthest north to that time in the Eastern Hemisphere. Commanded the first voyage through the Northeast Passage in 1878-70.

Karl Weyprecht (1838-81), German explorer. On expedition to Spitsbergen and Novaya Zemlya in 1871; with Payer, was leader of Austro-Hungarian expedition in 1872-74 which discovered Franz Josef Land, now called Fridtjof Nansen Land.

Sir Albert Hastings Markham (1841-1918), English naval officer and explorer. Rescued survivors of Polaris American expedition in 1873; commanded the Alert in Nares' expedition of 1875-76, which reached, without dogs, northern point not passed until 1895.

Julius von Payer (1842-1915), Austrian explorer and painter. With Weyprecht, discovered Franz Josef Land on expedition of 1872-74. Rest of life

devoted to painting pictures of his Arctic experiences.

George Washington De Long (1844-81), American naval officer and explorer. Led expedition, paid for by James Gordon Bennett, on ship Jeannette, which was crushed in ice north of Siberia in 1881. The party divided into three groups which set out for Siberia, and De Long and the men with him perished.

Adolphus Washington Greely (1844-1935), American army officer and explorer; served in Civil War. In 1881 commanded U.S. expedition to establish chain of 13 telegraph stations in Arctic. Reached most northerly point to that time, 83° 24′, and discovered new land north of Greenland.

Frederick Schwatka (1849-92), American army officer and explorer. In 1878-80 commanded expedition which discovered wreckage of one of Franklin's ships and graves of some of his crew. Explored course of Yukon River in 1883-84, and led Alaskan expedition in 1886.

Koolemans Beynen (d. 1879), Dutch officer, shared Young's two polar voyages, 1875 and 1876. Successfully interested his country in polar exploration. On Dutch schooner Willem Barents, made voyage in 1878 to Arctic to take deep-sea soundings and make natural-history collections.

Stepan Osipovich Makaroff (1848-1904), Russian naval officer; designed ice-breaker. On trip to Spitsbergen formed opinion that vessel of sufficient size and power could force a passage even to the Pole. Killed on duty in Far East during Russo-Japanese War.

Salomon August Andrée (1854-97), Swedish aeronaut; lost while attempting to fly over the North Pole in a balloon.

Otto Neumann Sverdrup (1855-1930), Norwegian explorer. Accompanied Nansen to Greenland in 1888, and was captain of the Fram, Nansen's ship, on expedition of 1893-96. Sverdrup brought the Fram back to Norway. Led unsuccessful attempt to sail around Greenland in 1898-1902; led Arctic expeditions of 1914 and 1920 to search for lost Russian explorers, and in 1928 to search for crew of the Italia.

Robert Edwin Peary (1856-1920), American naval officer and explorer. Explored Greenland in 1886 and 1891-92. Made several attempts to reach the North Pole between 1893 and 1903, getting only 174 miles from it on the last of these voyages. Became the first man to reach the Pole on April 6, 1909.

Baron Eduard von Toll (1858-1902), Russian explorer. Made expeditions to New Siberian Islands in 1885-86, 1892-94 and 1900-02. Discovered layers of fossil ice along southern coast of Bolshoi Island containing preserved remains of mammoths, rhinoceroses, etc. Perished on return trip from Bennett Island.

Fridtjof Nansen (1861-1930), Norwegian explorer, zoologist and statesman. Led first expedition to cross ice fields of Greenland, in 1888; and expedition of 1893, in the Fram, which aimed to reach the Pole by drifting. Left Fram at 84° and pushed on to 86° 14′, the farthest north yet reached. Led numerous oceanography expeditions.

Alfred Charles William Harmsworth, Viscount Northcliffe (1865-1922), English newspaper publisher; keenly interested in Arctic exploration and provided funds for a number of expeditions.

Frederic Hjalmar Johansen (1867-1923), Norwegian explorer. Accompanied Nansen toward North Pole, 1896, and Amundsen to South Pole.

Roald Amundsen (1872-1928), Norwegian explorer. Navigated the Northwest Passage and fixed the position of the North Magnetic Pole in 1903-06. Discovered the South Pole in 1911. Made successful voyage of the Northeast Passage in 1920, and flew across the North Pole with Ellsworth in 1926. Disappeared in 1928 on flight to rescue Nobile who was lost returning from North Pole.

Ludvig Mylius-Erichsen (1872-1907), Danish explorer. Led literary expedition in 1902-04 to explore unknown shores of Melville Bay, Greenland, and study language and customs of Eskimos. Led expedition of 1906-07 to chart coastline of northeastern Greenland. Perished on second attempt to reach Independence Bay.

Luigi Amedeo, Duke of Abruzzi, Prince of Savoy-Aosta (1873-1933), Italian naval officer and explorer. First man to ascend Mt. St. Elias in Alaska, in 1897.

Donald Baxter MacMillan (1874-), American explorer. A member of the Peary expedition of 1908–09. Between 1910 and 1937 led a number of expeditions to Arctic, especially Labrador, Greenland and Baffin Land.

•**Robert Abram Bartlett**, "Captain Bob Bartlett" (1875–1946), explorer, born in Newfoundland. Accompanied Peary expedition of 1897–98, and commanded Peary's ship, the Roosevelt, on voyage of 1905–09. Explored for Canadian Government in 1913–14, when his ship was crushed by ice near Wrangel Island; crossed ice to Siberia and returned with rescuers for his crew. Other expeditions to Arctic between 1917 and 1935.

Vilhjalmur Stefansson (1879-), explorer, born in Canada of Icelandic parents. On numerous trips to Iceland, Alaska, northern Canada, etc., for various museums and Canadian Government. Lived in Arctic for five years to learn how white men may live there comfortably.

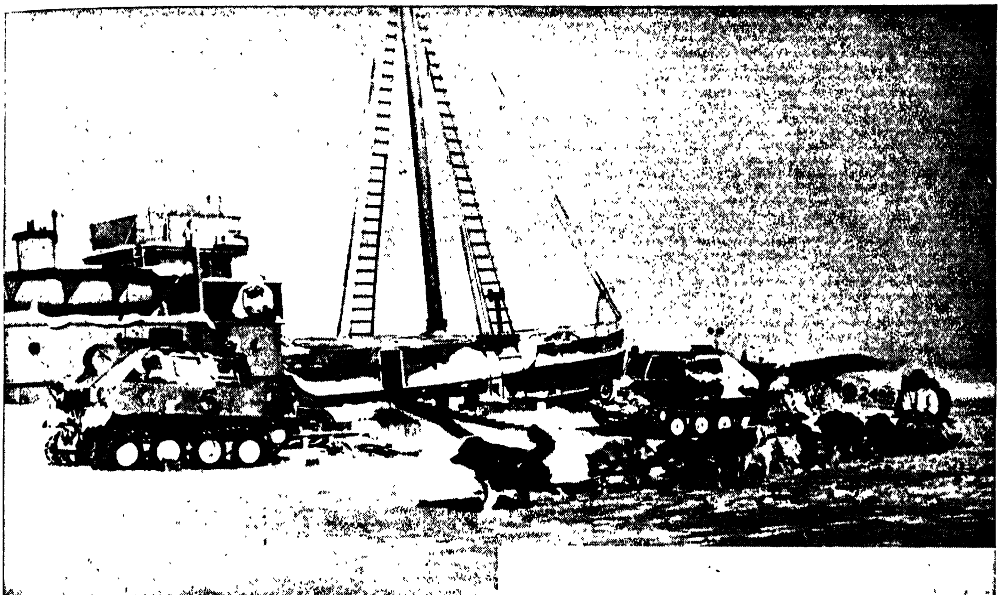
Lincoln Ellsworth (1880-), American explorer. Flew with Amundsen to 88° North Latitude. Flew over the North Pole, in airship Norge, May 11-13, 1926, with Amundsen and Nobile. Made Arctic expedition by submarine, with Wilkins, in 1931; and 2,300-mile airplane flight across Antarctic, in 1935, claiming 300,000 square miles of new land for the United States.

Umberto Nobile (1885-), Italian aeronautical engineer and explorer. Designed airships Norge and Italia. Flew across North Pole in Norge with Amundsen and Ellsworth, May, 1926; commanded polar expedition in Italia, 1928, and rescued after wreck of Italia.

Richard Evelyn Byrd (1888-), American naval officer and explorer. In charge of aviation unit of Navy-MacMillan expedition of 1925. With Floyd Bennett flew by airplane over North Pole, May 9, 1926, the first men to fly over the Pole. Flew from N. Y. to France, with three companions, in 1927. Flew over South Pole in 1929, and led several expeditions to Antarctic between 1928 and 1935, discovering new lands.

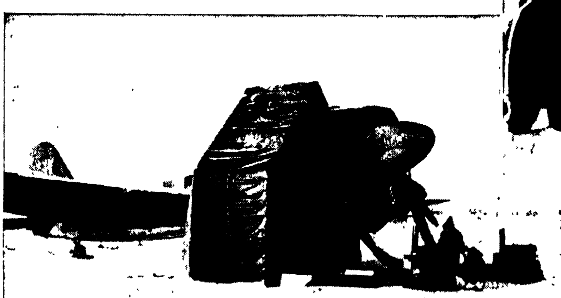
Sir George Hubert Wilkins (1888-), Australian explorer and aviator. On Stefansson's Arctic expedition of 1913-17, and several Antarctic ex-

NEW WAYS OF CONQUERING THE FAR NORTH



Men from the moving force of "Exercise Muskox," a Canadian exploring operation, try out an Arctic dog-sled, close to their modern snowmobiles, ship and airplane.

Men of "Exercise Muskox" learn to erect snow huts as protection against the Arctic blasts.



With a mobile hut, mechanics seek to keep the plane's engines warm.

Pictures on this page from Canadian Army photos

Snowmobiles start off on practice run, at Churchill, Manitoba, on Hudson Bay, before moving northwards.

peditions between 1920 and 1925. Commander of Detroit Arctic Expedition, 1926-27, Wilkins Detroit-News Arctic Expedition, 1928, Wilkins Hearst Antarctic Expedition, 1928-29, Wilkins Ellsworth Arctic submarine expedition, 1931. Organized Ellsworth Trans-Antarctic expeditions of 1933 and 1939. Wrote of Arctic travels.

Floyd Bennett (1890-1928), American aviator. On MacMillan expedition to northwestern Greenland in 1925. Was pilot on first flight over North Pole, May 9, 1926, with Byrd. Awarded the Congressional Medal of Honor.

SOME ARCTIC NAMES AND THEIR NAMESAKES

Alexandra Land, named for Queen Alexandra, wife of King Edward VII of England, to whom she was married when he was Prince of Wales.

Amundsen Gulf, named for Roald Amundsen, the Norwegian explorer.

Baffin Bay and **Baffin Land** or **Island,** named for William Baffin (1584-1622), the English navigator, who discovered Baffin Bay.

Banks Island, named for Sir Joseph Banks (1743-1820), English naturalist and president of the Royal Geographical Society.

Barents Sea, named for Willem Barents (d. 1597), Dutch navigator who discovered Spitsbergen.

Barrow Strait, Cape Barrow and **Point Barrow,** named for Sir John Barrow, English traveler and diplomat who promoted Arctic exploration.

Bennett Island, named for James Gordon Bennett, American newspaper publisher who promoted Arctic exploration.

Bering Sea and **Bering Strait,** named for Vitus Bering (1680-1741), Danish navigator who discovered Bering Sea. He died on Bering Island, near Kamchatka.

Boothia Peninsula and **Gulf of Boothia,** named for Sir Felix Booth, English business man and chief contributor to North-American expeditions of Sir James Clark Ross in 1829-33.

Borden Island, named for Sir Robert Laird Borden (1854-1937), former Canadian prime minister.

Brock Island, named for General Isaac Brock, Canadian hero of the War of 1812.

Davis Strait, named for John Davis or Davys (1550?-1605), English explorer.

De Long Islands and **De Long Fjord,** named for George Washington De Long, American explorer.

Fox Channel and **Fox Basin,** named for a ship, the Fox, which went in search of Franklin.

Franklin, former district of northern Canada, named for Sir John Franklin, the English explorer. In 1905 the district of Franklin was merged into the Northwest Territories.

Franz Josef Land, named for the Austrian emperor; since renamed Fridtjof Nansen Land.

Fridtjof Nansen Land, named for the Norwegian explorer.

Jan Mayen Island, named for the Dutch navigator who was supposed to have discovered it in 1611. Later it was established that Henry Hudson had visited it in 1607.

Jeannette Island, named for George Washington De Long's ship, the Jeannette.

Kane Basin, named for Elisha Kent Kane, the American explorer.

King Wilhelm Land (or Kaiser Wilhelm Land), named for Emperor Wilhelm I of Germany.

Long Strait, named for T. Long, the whaler who discovered Wrangel Island.

Meighen Island, named for Arthur Meighen, former Canadian prime minister.

Melville Bay, Melville Island, Melville Peninsula and **Melville Sound,** named for George Wallace Melville (1841-1912), chief engineer on De Long's ship, the Jeannette.

Nicholas II Land, named for the Russian tsar, now called Northern Land.

Nordenskjöld Sea, named for Baron Nils Adolf Erik Nordenskjöld, the Swedish explorer.

Otto Schmidt Island, named for Otto Yulevitch Schmidt, Russian scientist and explorer.

Parry Island, named for Sir William Edward Parry, the English explorer.

Peary Land, named for Robert Edwin Peary, who discovered the North Pole.

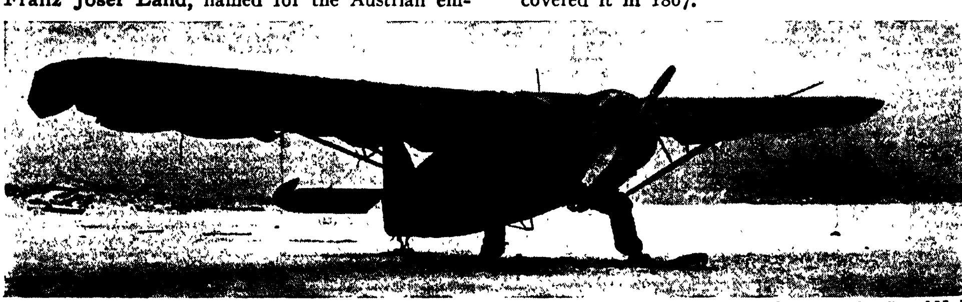
Prince Albert Peninsula and **Prince Albert Sound,** named for the husband of Queen Victoria.

Prince of Wales Island, named for the Prince of Wales who later became King Edward VII.

Sverdrup Islands, named for Otto Neumann Sverdrup, the Norwegian explorer.

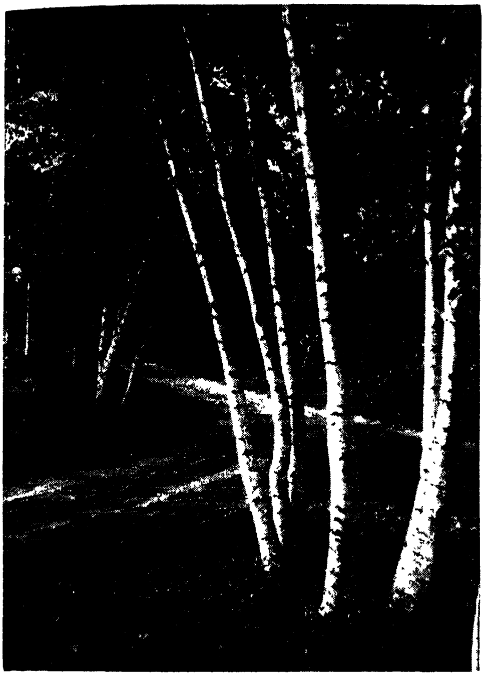
Victoria Island, named for Queen Victoria.

Wrangel Island, named for Baron Ferdinand Petrovich von Wrangel, or Wrangell (1794-1870), who sought the island unsuccessfully. Named for him by an American whaler, T. Long, who discovered it in 1867.



Standard Oil Co. of N. J.

As soon as rivers and lakes are frozen solid, planes convert from wheels to skis, for frozen surfaces.



U. S. Forest Service

Slim, graceful "ladies of the woods" — canoe birches along a winding lane in New England.

SOME IMPORTANT TIMBER TREES

TREES are planted and grown for various reasons. In parks they are cultivated for ornament, and certainly no landscape can be called perfect without trees; in orchards and gardens trees are grown for their fruits, and thousands of square miles are given up to the cultivation of oranges, lemons, apples, pears, plums, cherries and nuts.

But the greatest use of trees is for timber. In fact, men have found no satisfactory substitute for some of the uses of wood. All regions except the extreme north and the desert areas, and to some extent the rolling prairies, have their timber trees. In practically every country where trees grow, man has made use of the timber in some form or other.

The timber trees of the world may be divided roughly into two classes—the needle-leaved and the broad-leaved. The needle-leaved class are the conifers, whose leaves are shaped like needles; and the broad-leaved class includes all the other trees, such as the oak, elm, walnut, hornbeam, teak and mahogany. Another division sometimes made is into softwood and hardwood trees.

THE HALLOWED OAK OF ENGLISH HISTORY AND LITERATURE

Prominent among the broad-leaved varieties stands the majestic oak, hallowed especially by many historic associations from very early times. It is found all over Europe and in America, Asia and Africa. Altogether there are about three hundred species of oaks. The principal European species is *Quercus robur*. This is the oak of which we have read so many times in English history and literature. It is the only native oak of Great Britain, and is highly valued for timber. In Anglo-Saxon times it was more valued for its acorns, which furnished the principal food for hogs. When other food was scarce the acorns were eaten by man. This oak may grow as high as a hundred feet, but this height is rare. The wood is almost everlasting, unless it is attacked by insect pests.

The most important American oak is the white oak *(Quercus alba)*, which grows from Canada to the Gulf of Mexico and westward to Texas. The timber is excellent, though perhaps not so durable as that of the European oak. The chief western oak is the bur oak *(Quercus macrocarpa)*. The red oak and the scarlet oak also furnish valuable timber. The western, or Oregon, oak *(Quercus garryana)* is found only on the Pacific coast and is a valuable timber tree. The chestnut oak *(Quercus prinus)* has much tannin in its bark, and the timber is also used for many purposes. The pin oak *(Quercus palustris)* is a beautiful tree.

These are not all of the fifty species of oaks of North America, but we have room to speak of but two more, the live oak *(Quercus virginiana)*, which belongs to the South; and the black oak *(Quercus velutina)*, found from Ontario to Texas and known for its usefulness in medicine, tanning and dyeing.

A visitor to the seacoast in the South is sure to ask what the great spreading tree may be which has such hard shiny oval leaves. The hundreds of old acorns beneath the tree will tell him that it is an oak, but the leaves are very different from the thin broad kind he has known on other oaks. He will find much to interest him in this sturdy

evergeen tree that is found in the sandy soils close to the ocean.

Because this tree is green the year round it has been long known as the "live oak." Its leaves are thick and hard, and it can survive and grow in sandy places where the water soon sinks away, and where the wind is so strong that other plants with thinner and broader leaves can not live. Especially interesting, however, are those solitary trees seen on greatly exposed shores, whose struggle with the wind has been only partly successful. On the seaward side the wind is steadily killing the branches, while on the opposite side, protected somewhat by the mass of dead branches, the twigs are still growing. Such a tree literally grows sideways rather than up after the branches are draped with Spanish moss. The timber is excellent, but hard to work.

MODEL FOR LANDSCAPE ARTISTS, THE STATELY ELM

The elm is the very stately relative of the hop and the nettle, the fig and the mulberry. It grows ordinarily to a height of fifty to seventy feet, though some species may, in favorable circumstances, reach a hundred feet or even more. Often its girth is from ten to twenty feet, but sometimes it has been known to exceed fifty. No more beautiful tree is seen in a landscape, and artists have made much use of it in their pictures.

There are fifteen or sixteen species of elm, all living in the North Temperate Zone. The common European elm *(Ulmus campestris)* is often called the English elm because it grows best in southern England. It is a beautiful tree, more compact than most of our native elms, and has been widely planted as an ornamental tree in America. The wood is hard and is much prized. If kept dry or in water it is durable, but it decays in a damp situation. Another European elm, the Scotch, or wych, elm *(Ulmus glabra)*, has also been planted in America as an ornamental tree. In Europe the wood is used by boat-builders.

BOATS, BARRELS AND FARM IMPLEMENTS FROM AMERICAN ELM WOOD

We are so proud of the size and beauty of the American elm *(Ulmus americana)* as it grows in our streets and lawns that we seldom think of it as a timber tree. However, a considerable quantity of elm wood is used in small boats, barrels and farm implements. The elms for which New England and Canada are famous are of this species, but they grow everywhere east of the Rockies. Unfortunately many of the finest elms in New England have been killed by the caterpillars of the brown-tailed moth, a pest imported from Europe.

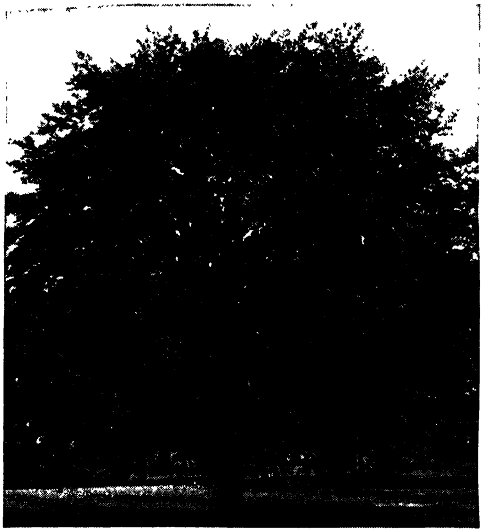
Other elms valuable for timber are the red, or slippery, elm *(Ulmus fulva)* and the rock, or cork, elm *(Ulmus racemosa)*. The wood of both of these is better than that of the more common American elm. The bark of the slippery elm furnishes a gluey substance used in medicine.

The hornbeam, a European tree, grows well in the poorest soil. It is often mistaken for the beech, which it closely resembles, though the leaves have not that glossy appearance characteristic of the beech. The hornbeam leaf is double-toothed at the edge. The wood is particularly hard and tough, and is much used for the cogs of mill wheels and in making agricultural implements. It has been introduced into this country, but is not very important as a timber tree here. The American hornbeam is a different species and does not grow so large, but the wood is very hard.

The beech is a fine-looking tree that many

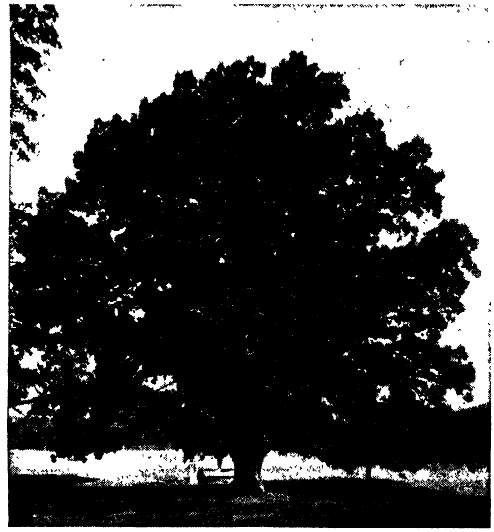
The Davey Tree Expert Co.
The short, flat needles of the Douglas fir.

L. W. Brownell
A quintet of rustling black-oak leaves.



L. W. Brownell

On a warm summer day, a spreading beech tree invites us to linger in its cool patch of shade. There is no lovelier tree for a sunny lawn.



U. S. Forest Service

A white oak, the noblest of all the American oaks. We notice it especially in the autumn, when its leaves turn a warm rusty red or golden brown.

think takes precedence for grace and nobility over all other trees. The American beech (*Fagus americana)* and the European beech (*Fagus sylvatica)* are much alike. There are other beeches in Asia and in the South Temperate Zone. The trunk of our beech assumes fantastic forms, with strange knobs and hollows, sometimes closely resembling a human head or an animal's face. The smooth olive-gray bark is generally covered with lichens and moss of various shades and colors. In autumn the leaves turn a rich orange-yellow, which gives a very beautiful appearance to the landscape. In a favorable situation the beech will often grow as large as an oak and reach a height of a hundred feet, with a circumference of thirty-six feet.

The wood is reddish white or light brown in color, and is largely employed in chair-making. Engineers like it for piles and works under water, since, if kept wholly submerged, it lasts for a very long time. When kept perfectly dry it also lasts well.

A FAIRY-TALE TREE, THE FEATHERY BIRCH

The poet Coleridge called the graceful birch tree the "lady of the woods." The silvery whiteness of the bark, the slender form of the tree, the smallness of the leaves, and the feathery nature of the branches give the birch a fairy-like appearance that adds to the beauty of any place where it grows.

There are about thirty species of birch, and the poet's description does not fit them all. He was referring to the white birch of Europe *(Betula alba)*. This tree is sometimes fifty feet tall and seldom grows to be eighteen inches in diameter. The wood is light brown and is used chiefly for cabinet-work and chair-making. An oil from the bark gives a pleasant odor. Our white birch *(Betula populifolia)* is not so attractive, and its wood is little used.

Of our dozen birches the most valuable are the canoe, or paper, birch *(Betula papyrifera)*, the yellow birch *(Betula lutea)* and the red, or black, birch *(Betula nigra)*. The Indians knew how to use the bark of the paper birch for canoes and as covering for their wigwams. The tough wood of the yellow birch is used in shipbuilding and for furniture, but as a timber tree the black birch is more valuable. It is the largest of our birches. The cherry birch, or sweet birch *(Betula lenta)*, is called the black birch in some sections. This has beautiful wood. Birch beer is made of its sap, and a fragrant oil is extracted from its leaves. The Indians dried the inner bark and boiled it with fish or meat.

Among timber trees a very high place is held by the ash, which grows from thirty to fifty feet. While it prefers a rich loam, it thrives in almost any soil. It is related to the olive, the lilac and the privet, and is a very

U. S. Forest Service

The white ash, a combination of elegance and toughness. We can recognize it in the springtime by the buds, which are ebony-black in color.

elegant tree. The toughness and elasticity of its wood combined with lightness make it eminently suited for wheels and for farm implements, and for boat oars, ax handles and spade handles, alpenstocks and so on. The ash can be recognized in spring by the blackness of its buds.

Many species of ash are found in America, Europe, Asia and Africa. The common ash of Europe *(Fraxinus excelsior)* is one of the most valuable timber trees. The wood of our white ash *(Fraxinus americana)* is quite as good and is much prized. Baseball bats are made of ash, and many other athletic implements also. The wood of the black ash *(Fraxinus nigra)* is used for much the same purposes and also for baskets. The wood of the red ash is not so good. The Oregon ash, which grows along the Pacific coast, is a beautiful tree and furnishes excellent timber. We have also a blue ash and a green ash.

There are many species of maples. Some authorities give nearly a hundred, but others class some of these as varieties only. The tree belongs to the North Temperate Zone, and especially to the Far East. North America has eight or nine species. The most valuable, from every standpoint, is the sugar maple *(Acer saccharum)*. The wood is excellent for floors, furniture and fuel; the sap makes maple syrup and maple sugar; and there is no finer shade tree. This is the national tree of Canada. The black maple is now often classed as a variety of the sugar maple, and not as a special species.

We have the silver maple, the red maple, the Oregon maple (all good timber trees), besides a number of shrubs that have little value for timber. The box elder *(Acer negundo)* is a true maple. In addition, many maples have been imported as ornamental trees, but none is common enough to make it important as a timber tree.

PRIZE FOR CABINETMAKERS, THE WOOD OF THE EUROPEAN SYCAMORE MAPLE

In Europe the sycamore maple *(Acer pseudoplatanus)* is a handsome tree sixty or seventy feet high, and the yellowish white wood is even more prized by cabinetmakers than that of its relative, the common maple. The tree is called sycamore because it was at one time wrongly supposed to be the same tree as the sycamore fig of Palestine, the tree into which Zacchaeus climbed, as described in St. Luke's Gospel. It has been widely planted in America, but generally does not do well. The tree we call sycamore, or buttonwood, is a plane.

The walnuts would be important timber trees if there were more of them. We have four native species. The black walnut *(Juglans nigra)* was once rather common, but the early settlers cut down so many of them that they are now rather scarce. The close-grained brown wood is used for gunstocks, furniture, and interior woodwork in houses and in ships. Because of its scarcity and fine qualities, it brings a high price.

The white walnut, or butternut *(Juglans cinerea)*, has become rare. The California walnut and the southwestern walnut are also found in the West. The so-called English walnut *(Juglans regia)* really came from Persia. It has been widely planted in America, and great groves may be found in California. Few of these trees are cut for lumber, as their nuts are too valuable.

HICKORY, THE FAVORITE WOOD FOR MAKING SKIS

Closely related to the walnuts are the hickories. They are found wild only in North America, though because of the value of their timber, they have been planted in European forests. Twelve species are recognized. The wood of all is valuable, but the shell, or shag, barks are the most common. The wood is used where it is subjected to strain, as in the running-gear of vehicles, handles for implements and so on. The pecan is also classed as a hickory. This tree

is too valuable to cut.

The chestnut *(Castanea dentata)* has been one of our most valuable timber trees, but a stubborn blight, probably introduced from China, has killed nearly all the trees the lumbermen have left. Chestnut wood is light but durable, and is used for furniture and fencing. Both the European chestnut *(Castanea vulgaris)* and the Japanese chestnut *(Castanea japonica)* have been introduced, but are not common.

While small quantities of lumber are obtained from many other broad-leaved trees, we can mention only the gums, and the tulip tree, or yellow poplar *(Liriodendron tulipifera)*. It would be proper to place both of these among the ornamental trees. The tulip tree is one of the finest of all trees.

HANDSOME MAHOGANY WOOD FROM THE COAST OF HONDURAS

Now we may speak of some foreign trees affording excellent wood. Mahogany, when it is good, is one of the most valuable of woods, and as much as $5,000 has been paid for a single log for cutting up into veneers. It is a West Indian and South American timber. There are several trees from which the wood called mahogany is obtained, but the true mahogany tree is the *Swietenia*, or Spanish mahogany. The tree grows perfectly straight to a height of ninety or a hundred feet, and provides large logs. It grows most abundantly on the coast of Honduras, and from there the best mahogany comes.

One of the most valuable timbers known is teak, which comes from an Indian tree related to our common vervain. It is a very widely distributed tree, growing in central and southern India and Burma, and from its southern limit in Java for over two thousand miles, to the 23° North Latitude. The best and most extensive forests are in Burma. The tree reaches the height of a hundred feet or more, and has oval leaves. Teak is used for building wooden ships and for masts, for bridges, and railway carriages, for furniture and for shop fronts. The leaves yield a red dye.

JARRAH, OR YELLOW JACKET, THE "MAHOGANY" OF AUSTRALIA

The jarrah, or Australian mahogany, is one of the eucalyptus group of trees, and is a native of Australia, where it grows in abundance. It has a light-colored bark that has given the tree the name of yellow jacket. The wood is hard and very much like mahogany, and is durable if kept dry.

So far we have spoken of the broad-leaved trees, most of which shed their leaves in the fall. Now we come to the conifers, or cone-bearing, narrow-leaved trees, most of which do not shed their leaves at one time, and hence are called evergreens. However, the tamaracks and one of the cypresses shed their narrow leaves in autumn, and some of the broad-leaved trees bear cones. The botanist distinguishes them by the fact that their seeds are naked. The name "gymnosperm" means "naked seed."

Included in the great pine family are the pines proper, hemlocks, spruces, firs, sequoias, cypresses, cedars and junipers. There are about eighty species of pines, and more than half of them are found in North America. To describe them all would require more space than we can give. The most important are the white pine, the longleaf pine, the shortleaf pine, the yellow pine and the pitch pine, and the red, or Norway, pine of the East; and in the West are the sugar pine, the mountain pine, the Rocky Mountain white pine and the western yellow pine. The gray pine is found north to the Arctic Circle. The wood of the last named is not good, but in the region where it grows there is little other.

The wood of some of these pines is soft and white. In others it is dark, hard and full of resin. In the past, pine has been so abundant and so cheap that it has been used

Mahogany Association, Inc.
A mahogany tree of the Central American tropics.

more than any other wood, but the supply is no longer abundant.

North America has seven of the known species of spruce, and some of them are valuable timber trees. The wood is light and strong and is used in making musical instruments, but most of the wood goes to the paper mills. In the East are the white, black and red spruces. The tideland spruce and Engelmann's spruce are the most valuable western spruces. The spruces are more valuable for pulp than for timber.

BALSAM FIRS FOR FRAGRANCE, AND WESTERN FIRS FOR TIMBER

Closely akin to the spruces are the firs. The two balsam firs of the East are worth little for timber; but in the West are several valuable species. The red fir is a magnificent tree, but its wood is coarse and weak. The noble fir, and two trees both called white firs, are also found on the mountain sides.

One of the finest timber trees of the West is the Douglas fir, or Douglas spruce, which often towers more than three hundred feet. It furnishes large quantities of beautiful lumber. Much of it is marketed under the name Oregon pine.

Several species of hemlocks are cut to a limited extent, but there are other more important conifers. It is not always realized that the sequoias belong to this group. There are two species, *Sequoia gigantea,* the "big trees" of California, and *Sequoia sempervirens,* the redwood. The wood of the big tree is valuable only because there is so much of it; but the wood of the redwood is excellent, and is much used.

CYPRESS AND JUNIPER, CALLED "CEDARS" IN THE NEW WORLD

Though there are no true cedars in the New World, half a dozen or more trees are called by that name. One, the white cedar *(Thuya occidentalis),* is an arborvitae; the white cedar of the South is a cypress; and the common red cedar of the East, which furnishes wood for our pencils, is a juniper. Now let us end our list of American timber trees with one of the most interesting of all.

Like a pine tree, the cypress bears a cone, which puts it into the pine family, but in numerous other ways it is very different from a pine. The trunk widens prominently at the base, so that the tree appears to be well braced; the bark is thin and rather smooth; the leaves are very small (a half inch long) and are arranged on opposite sides of slender twigs. Late in the fall these are cut off so that this tree loses not only its leaves in winter, but also the end twigs on which the leaves are borne. But especially to be noticed are the queer "knees" that, like a flock of youngsters, come up around the base of the tree. They are, however, not young trees at all, but merely post-like upgrowths from the roots. They bear at their tops a lot of soft bark through which necessary oxygen from the air may slowly filter to sustain life. Plants, like men, must have air if they are to live.

The cypress swamps are not very attractive to those who fear dark and gloomy places. The water out of which the trees rise up is as dark as black coffee. The hummocks here and there, when one steps on them, show the soil to be one of a soft, black, mucky kind. Numerous shrubs and small trees are often present, which make the swamp even darker and more jungle-like. The poisonous water-moccasin snake may be seen crawling among the lower branches or swimming stealthily through the black water. All in all, a cypress swamp is a forbidding kind of forest.

THE TREES THAT FELL TO THE PIONEER'S AX

Two centuries ago North America had more valuable timber trees than any other continent. In fact, there were so many that the settlers looked upon them almost as enemies to be cut down and got out of the way. Hundreds of thousands of fine trees were cut down, piled into heaps and burned.

When the lumbermen went into the forests they were generally careless. They used only the best parts of the trees, and the remainder was left to rot on the ground. Forest fires have destroyed the trees on many thousands of acres both in Canada and the United States, causing the loss of thousands of lives and millions of dollars. Now the end of some species of hardwoods is in sight, so far as use for timber is concerned.

CONSERVATION, A TASK FOR BOTH CANADA AND THE UNITED STATES

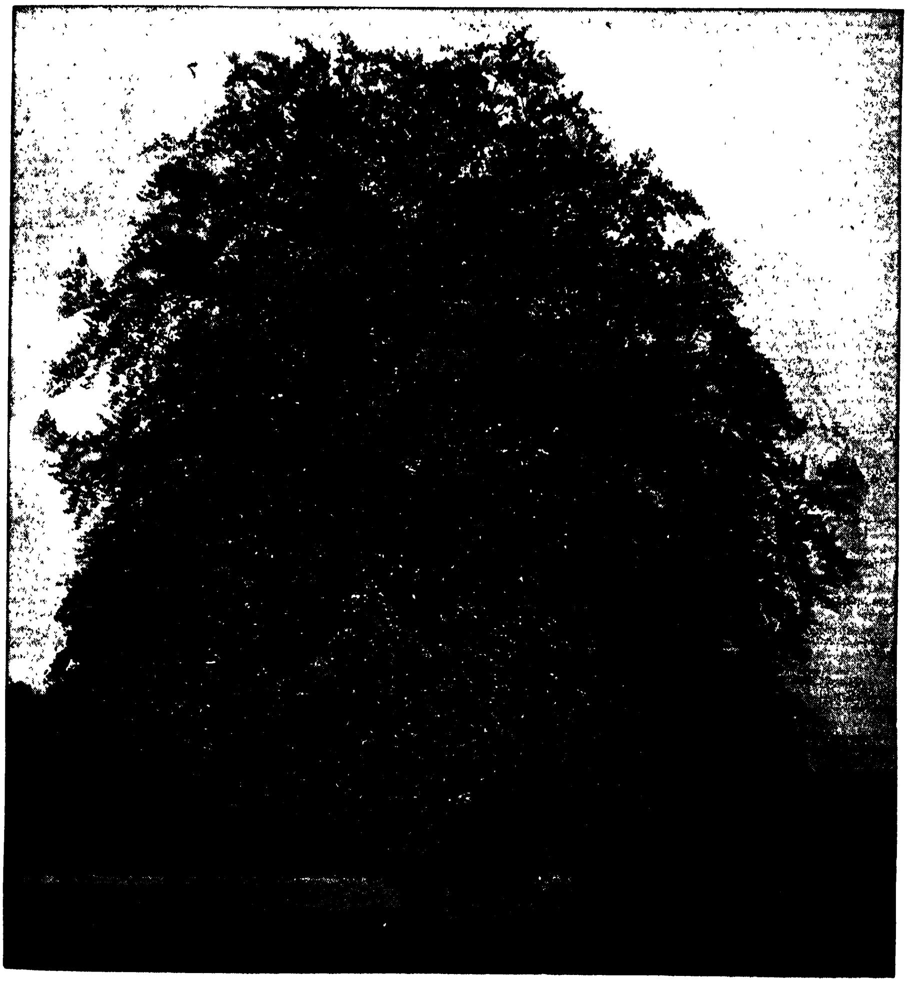
Since the population of the United States is so much larger than that of Canada, of course destruction has been greater, but even Canada has not much hardwood left for export, though her forests of conifers are still large. In both countries wood is being used up faster than it is growing. Fortunately something is being done to restore the forests.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 4381.

THE WIDE-SPREADING BEECH TREE

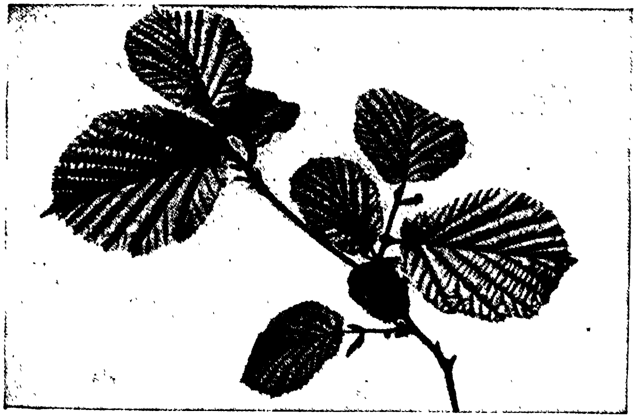
The flowers of the beech are like tassels on the ends of strings, and the nuts are good to eat.

The beech leaves, that blaze in the autumn sun, were formerly much used for stuffing beds.



The beech is one of the most beautiful trees in our woods. In Europe beeches are sometimes grown as a protection for other growing trees, but in this country it is found that they will crowd out other trees, as their thick foliage and wide-spreading branches keep out the sunlight. It is easy to find the beech tree by its smooth gray bark, and oblong heavily veined leaves.

THE TALL AND STATELY ELM TREE



The leaves of the elm are covered with hairs which may sting the skin like the nettle, though less severely. The elm is related to the nettle.

Elm flowers grow, not in catkins, but in little red tufts.

The oak tree is scarcely more stately than the elm, which also grows to a great age. Its wood is hard and of great value for building purposes. The tree in this picture is an English elm often planted in our cities and towns. The more graceful American elm is shown on page 4516.

THE OAK, THE HERCULES OF THE FOREST

The green tassels we see on oak trees are the staminate flowers. It is from the smaller pistillate flowers that acorns come.

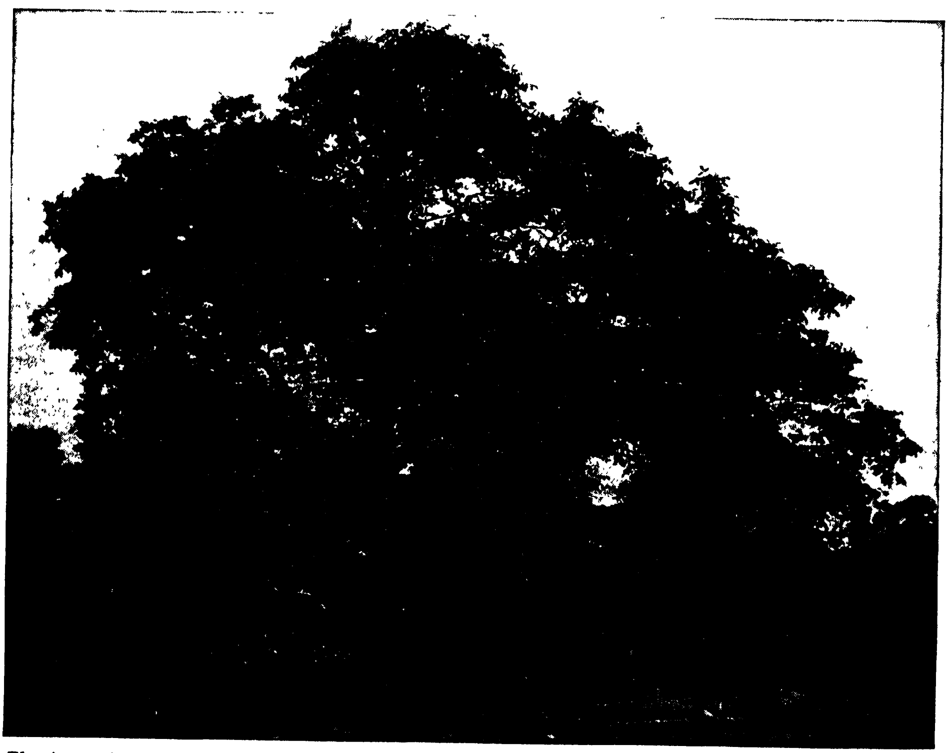
We all know the wavy leaves of the oak, which are often attacked by insects. It is said that over 1,500 kinds of insects feed upon the oak.

There are nearly three hundred different oaks, of which about fifty are American. This is the European oak of which we read so much in English poetry. We may compare it with the white oak of America, which has a fine dome-like head.

THE WALNUT, "THE FOOD OF THE GODS"

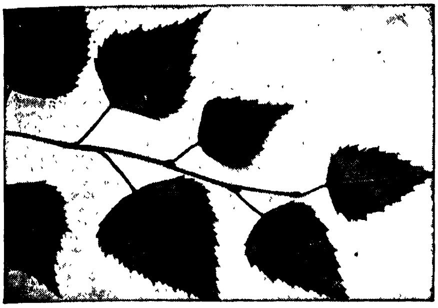
These long catkins are the staminate flowers of the walnut. The pistillate flowers are small and insignificant. Three are on the lower shoot.

The leaf is divided into spear-like leaflets. In Germany no young farmer used to be allowed to marry until he had planted some walnut trees.



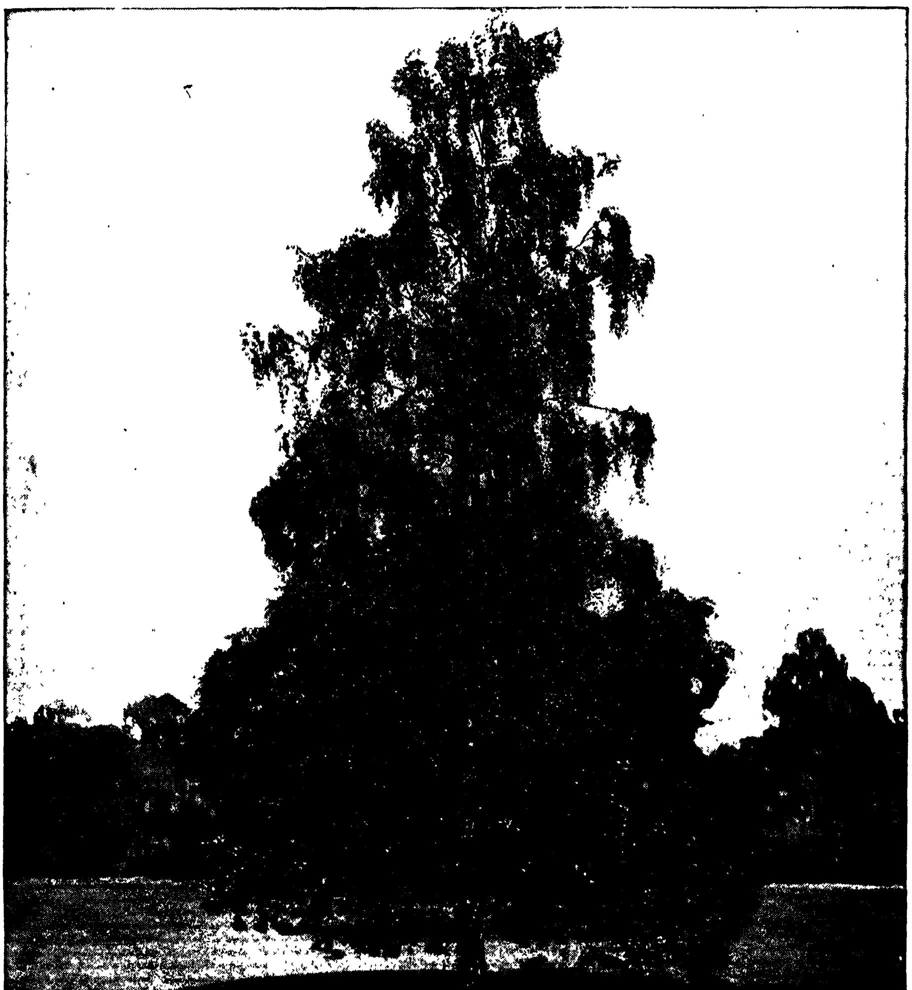
The tree which bears the walnut of commerce, called the Persian walnut, French walnut or English walnut, came, as we can tell by its names, from the East through Europe.

THE BIRCH, THE LADY OF THE WOODS



The birch is one of our most common forest trees. Its leaves are small, and vary in shape.

The flowers, in the form of hanging catkins, are full-grown in April, and are dark crimson.



The birch thrives in extremes of heat and cold. From its graceful appearance it has been called "the lady of the woods." English boys know the use to which the twigs were formerly put in British schools, where "birching" still means whipping. This is the European white birch.

THE COMMON EUROPEAN MAPLE

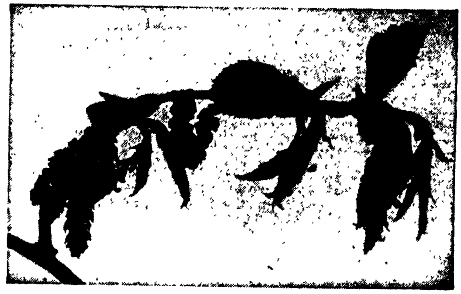
When Tennyson wrote of the maple that it would "burn itself away," he referred to the leaves, which change to red or yellow in October.

The greenish yellow flowers are quite small, and develop into curious winged seeds known as "keys." These become crimson and brown.

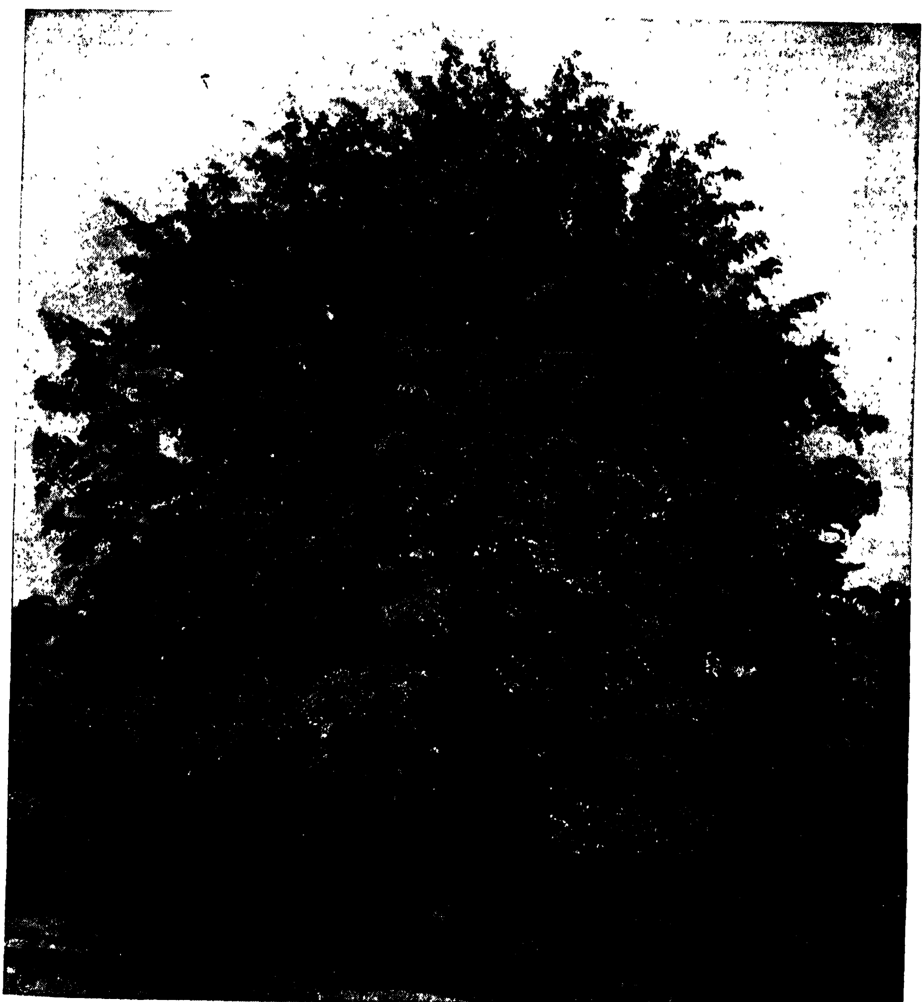
The beauty in form and foliage of the maples, their fine color in autumn, and their rapid growth, make them a favorite shade tree for streets and lawns. The sugar maple is shown on page 4511.

THE HARD HORNBEAM OF THE FOREST

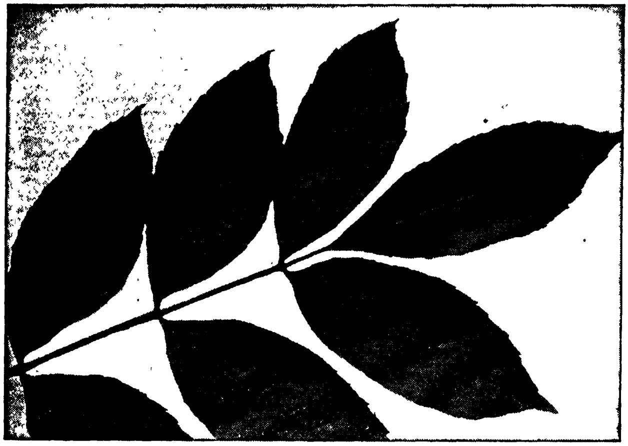
The rough, toothed leaves of the hornbeam turn orange and scarlet in the autumn.



The flowers of the hornbeam are in the form of catkins and are pale yellowish in color.



The hornbeam is a common tree, but many people mistake it for the beech. As a matter of fact, the leaves, the flowers and the trunk are all different from those of the beech. The hornbeam is so named because of the toughness of the wood, and is sometimes called hardbeam or yoke-elm.

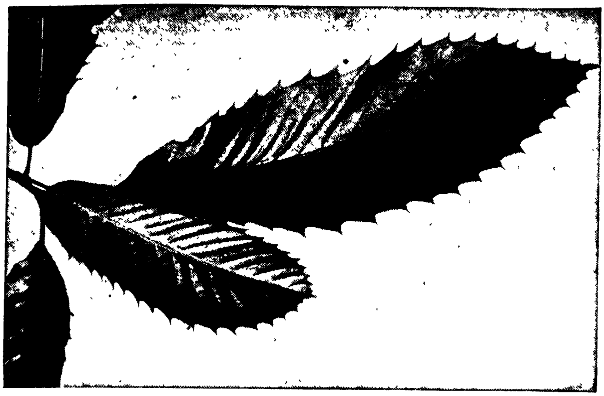


Cattle and horses like ash leaves, but it is said that if cows eat them the milk does not make good butter. They come late and fall early.

The flowers, which come before leaves, are unattractive.

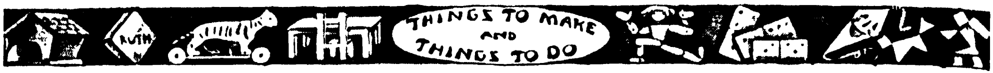
The ash is wonderful in grace and strength, and merits its title, "the Venus of the woods." This is the European ash. There are many varieties in America. An American ash is shown on page 4509.

THE GREEN AND GOLDEN CHESTNUT



The glossy leaves of the Spanish chestnut, which are nine or ten inches long, change in autumn from a rich green to a golden yellow, and then to brown. The yellow flowers are small, but striking.

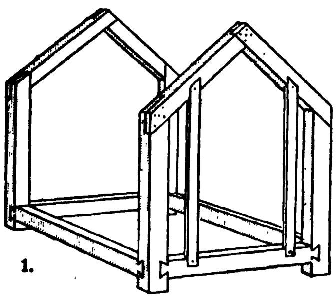
The Spanish chestnut, also called the sweet chestnut, is the tree from which we get the nuts for roasting. In parts of Italy poor people eat chestnuts instead of bread. Chestnut trees grow to a great age. They are closely related to the North American chestnuts, among which is the chinquapin.



MAKING A KENNEL FOR A DOG

THE size of your dog kennel will depend upon the size of the dog that is to occupy it. In making the kennel you must consider the comfort as well as the health of the dog for which it is to serve as a house and a sleeping-place. Select a place for the kennel where it will not be too much exposed in bad weather and where it will be sheltered from cold and biting winds.

The kennel must be made so that the flooring stands a little way off the ground. The floor should be dry even in wet weather. Remember that dogs take cold as well as human beings and they too love warmth and comfort. Also we must provide ventilation, so that there is always a current of air through the kennel. The dog's bed should keep him comfortable. A piece of rug or carpet or some clean straw will serve the purpose very well indeed.



1.

The length of the kennel inside should be half as long again as the dog that is to live in it. The width inside should be great enough to allow him to turn around without any difficulty.

The first thing to make is the frame of the kennel; this is shown in figure 1. The wood used should be 2 inches square. This will be strong enough if you join it properly where the different pieces meet. Figure 1 shows how the pieces are joined together at the corners. Care should be taken to make the joints fit well, because it is upon this that the strength of the kennel will depend.

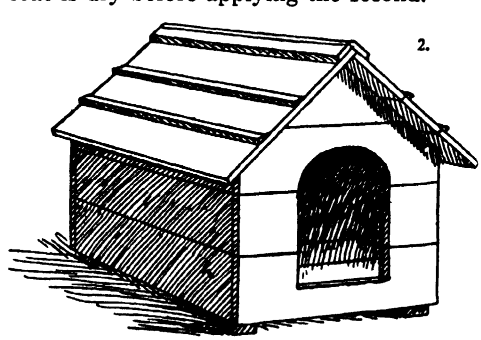
After the frame is completed, make the floor and walls. The floor boards should be thick—not less than ¾ of an inch—for thickness means warmth. They are laid across from side to side on top of (not under) the long frame-pieces seen in figure 1, and they are nailed in position with good strong nails. Now put on the sides, made of pieces of wood running from front to back, as seen in figure 2. This wood should be not less than ½ inch thick. It is important to have the edges of these boards smooth and straight, so that you can put the pieces tightly against each other, without leaving long cracks through which a draft would come into the kennel.

The front and back are made and fitted next. Make the back boards similar to those from which you made the sides of the kennel, and then nail them across. At the top, saw the ends off so as to slope to the shape of the sloping frame that forms each side of the roof.

Now for the front. This is made exactly the same as the back, except that you must leave an opening with an arched top to form the doorway. Mark out the rounded shape with a pencil, or cut out a paper pattern. Cut out the door by following the marks with a jigsaw or with a chisel and hammer.

You still have the two sloping roof-sides to put on. The boards for the roof should be fairly heavy. They should project about 3 inches over the front and back and about 2 inches over each side. This prevents the rain from running down from the roof on to the sides of the kennel. Next put strips of wood cut to the shape seen in figure 2 over each seam in the roof, so as to prevent the rain from finding its way into the kennel. Finally, bore five or six small holes through the side walls under the projecting roofs, so as to provide ventilation.

You may paint the outside of the kennel with two coats of paint. Wait until the first coat is dry before applying the second.



2.

HOW TO KEEP YOUR DOG HAPPY, HEALTHY AND WISE

INSTRUCTIONS FOR THE CARE OF DOGS

IF you are the proud owner of a dog, you know he is the best dog in the world. No other dog could be such a smart, loyal, fun-loving companion as yours. And because he is the finest dog you know, you want to take very good care of him.

HIS "HOME"

Unless you can exercise him in a park, it is unfair to keep a large dog in a city apartment. Just as his kennel should be large enough to accommodate him comfortably, so should his other surroundings match his size. This does not mean that a small dog needs no "runs" or exercise; it means that a dog weighing over 30 pounds, and even small hunting dogs like the beagle, must have space for roaming.

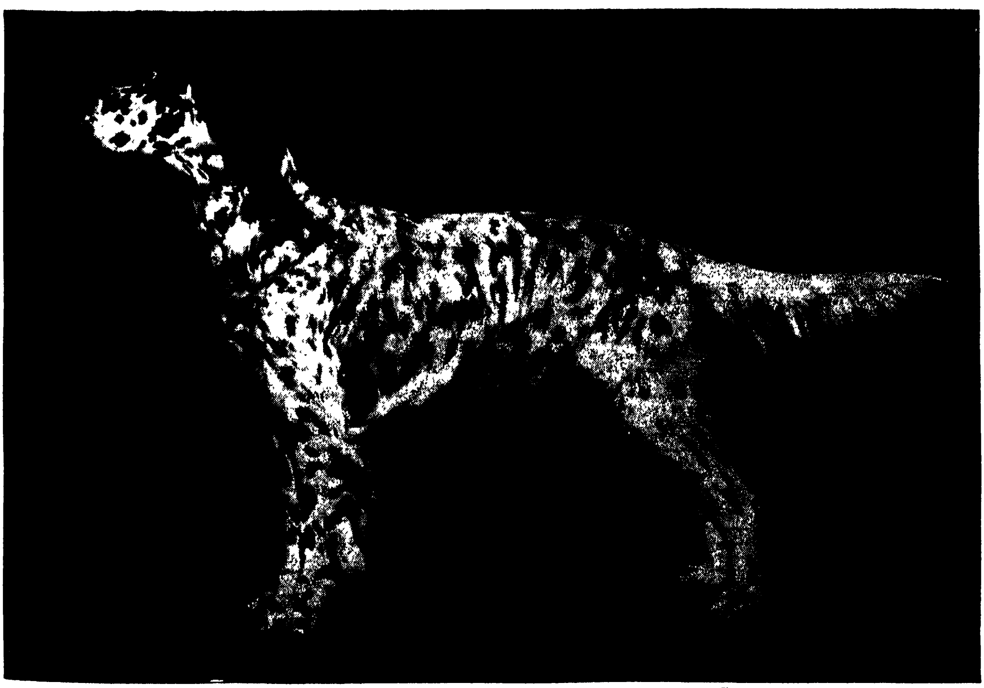
If you live in the country and your dog remains outdoors in fair weather, he should have a kennel in which he can stand up or lie stretched out. You will find kennel-building instructions on the facing page. Spread straw, excelsior or wood shavings liberally over the floor and change them weekly. Always place the kennel in the shade.

In the house your pet can have a bed of his own. An old rug or discarded pillow, placed in a basket or on the floor in a corner, will not only keep him comfortable but will also save the furniture.

Never shut your dog into a small space or tie him up for long periods of time. Close confinement will make him unmanageable when you do let him loose.

HIS "DAILY DOZEN"

Just as you play ball, run or swim to be healthy and strong, so your dog needs play and exercise for his well-being. To provide



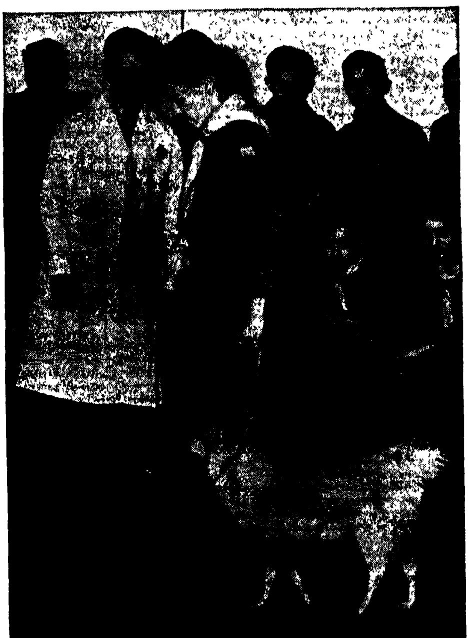
Courtesy, The American Field

This alert and beautifully marked dog is a particularly fine English setter, one of the hunting breeds. It is in pointing position, by which it indicates the presence and location of game. Such a dog is trained to stay perfectly still in that position until its master has seen the game to which the dog points.

him with proper exercise, teach him to chase and "fetch" a hard rubber ball, large enough so that he cannot swallow it. A few minutes of this game once or twice daily will be as much fun for you as for him and will give him the running he needs to keep fit. When he learns to "heel," you and he can have many happy hikes together.

HIS "CLOTHES"

Only short-haired and toy dogs require blankets or sweaters in cold weather, though



Courtesy, Disraeli—ASPCA

Teaching the dog to heel on leash. The dog walks to the left of the person. The leash is held in the right hand and controlled with the left.

even the longer-haired varieties appreciate winter overcoats when they remain outdoors too long without exercising.

In very warm weather long-haired or wooly dogs are sometimes shorn of their heavy outer coats. If your dog is clipped for summer, be sure it is done early enough to allow the full coat to grow in by winter. And speaking of weather, if you have a bulldog, keep him as cool as you can in the hot months. Due to their difficulty in breathing, short-nosed breeds suffer keenly from heat.

To keep your dog clean, brush his coat vigorously two or three times a week and comb out burrs and matted hair. Many dog experts claim that soap and water weaken a dog, and if you brush him thoroughly and regularly, few baths will be necessary.

HIS "DIET"

To give him a good start in life, a puppy should stay at his birthplace until he is at least two months old. At that age, and until he is four months old, he should have four or five meals a day. In the early morning, give him puppy biscuits soaked in cow's or goat's milk. At noon, he may have warm, not hot, vegetable or beef soup. Then at five o'clock comes his dinner of raw or slightly cooked chopped beef with a well-done vegetable. At night, a saucer of milk, given just before you go to bed, will help to tide him over until breakfast.

The quantity and frequency of his meals depend on his size and weight. If he is thin, give him one meal extra a day. It is better to feed your puppy a little, often, than to give him big meals only two or three times a day.

While he is from four months to a year old, you may feed him three meals a day, eliminating the bedtime dish of milk. After a year, your dog may be fed twice daily—a saucer of milk and dog biscuits in the morning, or just the biscuits if he is doing well, and the main meal of meat and a well-cooked vegetable at five or six o'clock.

Keep fresh cool water before your dog at all times!

Since the dog is largely a meat-eating animal, his main food should consist of beef—with lamb or liver, always well done, given occasionally for variety. Poultry is not good for dogs. All vegetables except those in the cabbage family are recommended, but remember that they must be well-cooked. Potatoes, bread and candy might upset your dog and will certainly make him fat. For the same reason, tidbits from the table are undesirable.

If you want to give your dog a special treat now and then, let him have a small piece of sharp American cheese—he will enjoy it just as you like candy, and in small quantities it will not hurt him. A hard bone is also a favorite, but be sure there are no sharp, jagged edges or splinters on it. Beef bones are best; chicken bones are dangerous. If your dog gnaws at a chicken bone, it may break in a number of small fragments and he may gag on them.

If your dog has a poor appetite take him

to a veterinarian. In fact, if he ever falls ill, rush him to the "dog doctor" at once.

HIS "SCHOOLING"

A trained, obedient dog is like a well-mannered, considerate person—both have many good friends. Naturally you want your friends and neighbors to admire your dog, and a few minutes each day teaching him to behave properly will assure that he is always a pleasure, and never a nuisance, to you and others.

In teaching your dog, remember always to encourage him when he does well by petting and saying "Good dog" in a friendly and affectionate tone. When he makes a mistake, do not shout at him, and never whip him. Such serious punishment may frighten and confuse him so much that you will not be able to teach him anything. When he does wrong, scold him by saying "No, no!" Dogs are very sensitive to the tone of the voice, and a stern "No!" will do as much to convey your displeasure as a whipping, without breaking his spirit.

It is a good rule, when speaking to your dog, to use the shortest words possible and as few of them as necessary. Always use the same command in each trick—don't say "Heel" one time and "Come here" at another time, when you want him to walk beside you.

Whenever you are giving your dog a lesson, be sure there are no other dogs or disturbing influences to distract his attention. Do not make any one lesson too long.

Housetraining—If your dog is kept in the house, he should be taken outdoors frequently and at regular intervals. A young puppy should go out seven or eight times a day. Any dog, whatever his age, should be taken out early in the morning and also late at night.

Courtesy, Newburgh, N. Y., News—ASPCA

Demonstrating the correct method of combing a dog's hair after bathing. The dog is a cocker spaniel.

Scold your dog for misbehaving only if you catch him in the act. If you punish him later, he may have forgotten the reason for his punishment.

A young puppy may be trained to newspaper at first. As soon as he has misbehaved, he must be scolded and placed on the paper or taken outdoors. He will soon learn to associate these actions with clean habits.

Leash-breaking and "Heel"—If your dog has never worn a leash and collar, let him run around loose with them on for a while. After he is used to them, you can then hold the leash in your hand. At first the dog will jerk away, but if you pull him gently back to you and give him a piece of cheese each time he walks quietly by your side, he will

soon learn it is wiser to stay close to you. Each time you pull him to your side, say "Heel," and in a few lessons he will heel at your command without the pull. Once you have trained him to heel, try it without the leash. If he does not heel at once on command, continue the lessons with the leash for a while longer.

"Stay"—For the times when you do not want your dog to follow you, it is helpful if you have trained him to "stay." Place him in one spot, either in a sitting or lying-down position, and each time he moves repeat the word "Stay," forcing him back. At first do not make him stay too long, but lengthen the periods a little more with each lesson. When you have decided he has stayed long enough, you can call him and reward him.

"Fetch"—Dogs take pride in carrying their masters' slippers, newspapers or any object which is not too large or heavy. You can teach your dog this trick by throwing a ball or a stick and repeating the word "fetch" as he runs for it. If he does not understand, lead him to the object and place it in his mouth. Every time he drops it, replace it in his mouth, repeating "fetch." Once he has learned to hold it, you can get him to bring it to you by calling him. After he has learned to run after, pick up and bring the object to you, you need not call him—the word "fetch" will tell him what he is to do.

Never scold your dog for barking unless you make sure he is noisy without cause. If you train him to be silent, he cannot tell you when there is danger.

Simple tricks, like "Stand Up," "Walk," (on hindlegs); "Roll over," and "Speak" can be taught by placing your dog in the required position and rewarding him with a piece of cheese.

To your dog you are a king, to be loved, respected and obeyed. Treat him well, and he will be your devoted companion.

Article by Elsworth S. Howell, Licensed Judge of The American Kennel Club.

Courtesy, Boy Scouts of America

Teaching a dachshund to obey the order "Lie down!" Gentleness and patience can work wonders in dog training.

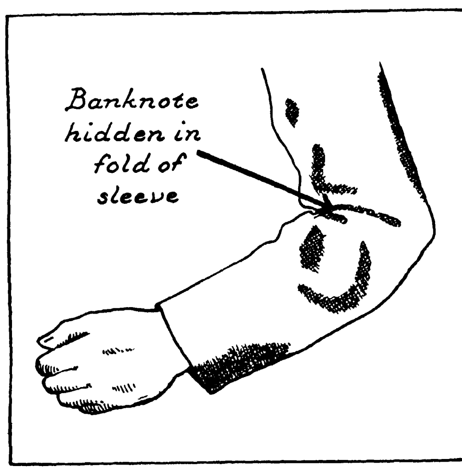
BUILDING UP A NEVER-NEVER LIBRARY

YOU will find it great fun to build up this unusual library. It will be inexpensive, too, for the books in it will not cost you a single cent! Let's see; we might begin with Henrietta Mann's fine book on Cannibals. Postscript, by Adeline Moore, would also be very appropriate. It's true that these books never existed, but what of that? Our Never-Never Library is made up of non-existent books, written by purely imaginary authors, whose names must have some connection with the titles of the books they are supposed to have written. Thus Henrietta Mann (Henry et—that is, ate—a man) is an appropriate name for the author of a book on cannibals; while the author of Postscript could not be more aptly named than Adeline Moore (Add a line more).

Here are some other titles for your Never-Never Library: The Dunce, by M. T. Head (Empty head); Springtime, by Teresa Greene (Trees are green); Repent at Leisure, by Marion Haste (Marry in haste); The Pet of the Ancient Mariner, by Albert Ross (Albatross); Traffic Perils, by J. Walker (Jaywalker); Hunger, by Nora Bone (Gnaw a bone). See how many new titles you can add to the library list.

A MAGIC FEAT

HERE is a very simple trick that will prove puzzling to an audience. The performer faces the spectators and holds out his hands toward them. Yes, they are empty. He turns them palm-side up, palm-side down; he spreads out his fingers. No, there is nothing hidden. Finally the performer pulls up each coat sleeve in turn to show that he has nothing up his sleeves. Yet, a few moments later, he rubs his hands together and, lo and behold!, he produces a banknote from thin air.



Here is the explanation. Before he presents the trick, the performer folds a banknote a number of times, so that it occupies very little space. Then he places it within a fold of his left coat sleeve, as shown in the diagram. He should keep his left arm slightly bent, so as to keep the fold in position.

When the performer pulls up his left coat sleeve to show that there is nothing up the sleeve, he takes the note from the fold with his right hand. When he brings both hands together, he manages to get an edge of the bill between his fingertips. A single energetic flip and the bill will suddenly be unfolded.

A PEANUT RELAY RACE

HERE is a delightful game in which a number of children at a party may take part. These children are divided into two teams, each team having the same number of players. One boy or girl is chosen umpire. Two pieces of white tape are stretched parallel to each other at opposite ends of the room. Cord or string will do for this purpose if tape is not available.

Let us suppose that the players of the first team are called A, B, C and D and that the players of the second team are E, F, G and H. Players A, C, E and G line up at one of the parallel tapes; players B, D, F and H line up at the other. Each player holds his left arm straight down by his side. The umpire winds a piece of cord or cloth around the body so that the left arm is held in place against the side of the body and then he ties the two ends of the cord. This he does to all the players in turn. Each player's right hand is to be left free.

Players A and E are now each provided with a table-knife which is held in the right hand so that the flat blade is parallel with the floor. Then the umpire places a peanut in the shell upon each knife-blade in turn. When the umpire says: "Go!" A and E start toward the opposite tape. Each tries to be the first to reach it. This is no ordinary race, however. The peanut must be kept on the knife-blade. If it drops off, the player must put it back on the knife again. Of course he will not be able to use his left hand to help him pick up the peanut. He will have to put his knife-blade under the peanut and then slowly bring the knife up, balancing the peanut on the blade carefully. Of course, while he is getting the peanut on the knife again, his opponent will be taking advantage of his misfortune and will be making rapid progress in the race.

When Player A has reached the other tape with the peanut still upon the knife-blade, he hands over the knife and peanut to his teammate B, who at once starts for the opposite tape. B must also keep the peanut upon the knife-blade. When B reaches the tape, he hands over the knife and peanut to C, and C in turn will give them to D. In the meantime E has given his knife and peanut to F, F has given them to G and G to H. The race is won when D or H crosses the tape ahead of his opponent.

Here is one race at least in which speed is not the most important factor. If you run, the peanut will almost certainly fall from the knife-blade. You should walk toward the opposite tape; you will be doing well if you manage to walk rapidly. You must be careful, too, not to drop the peanut when you hand the knife over to a partner.

WHO AM I?

HERE are some interesting riddles for you to solve. The solutions are given on page 4846. See how many of the riddles you can work out for yourself.

1. I am often driven this way and that, for people hate to see me settle down. All shun me, except when I am made of gold. If you let a man throw me in your eye, you must be very stupid. Who am I?

2. My head and tail are plump; my waist is slender. It is all the same to me whether I stand on my head or my tail. But if you cut my head off, there will be nothing left.

3. Five hundred begins me, five hundred ends me and there is a five in my middle. In between you will find the first of all letters and the first of all figures. Join together all my parts and you will have a famous giant-killer.

4. My mouth is always open and is generally bigger than any other part of me. I am often crossed, but that does not make me lose my temper. Beware of me when I rise, for then I may become dangerous, even though I do not leave my bed. If I do, be prepared to run for your lives.

5. I am not a drunkard, yet when full of wine, I often stand on one leg. If you behead me, I'll stand on two legs; chop my head off again and I'll stand on four, silly creature that I am!

6. I sometimes chase children when they play and they can never run away from me. I weigh nothing, but I'm not at all light. I'm quite big at breakfast and dinner, but at lunch you may find it hard to see me. I'm not the man in the moon, although I've been there; but that's the fault of the earth and the sun!

HOW TO BLOW A BRICK OVER

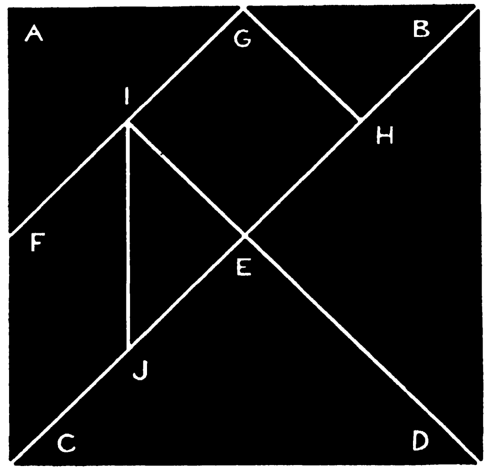
AN ordinary building brick is set up at the end of a table. Then you are to challenge one of your friends to blow it over. He will puff away at a great rate, but the brick will remain firmly in place. It is now your turn to blow. You first place the brick upon a paper bag, leaving the open end of the bag dangling over the edge of the table. Then gathering up the edges of the open end, you blow into the bag. As the air rushes in, the bag will gradually fill and the brick will topple over.

THE LITTLE BLACK TANGRAMS

TANGRAMS are little black cards of various shapes that are used to form a great number of different designs. These cards are said to have been first designed in China many centuries ago. We can make a set of them by taking a square of black cardboard and cutting it as shown in figure 1 on this page.

Cardboard that is black on both sides may be bought at most stationery stores. If you have any difficulty in getting black cardboard, you can make a satisfactory substitute by pasting black paper over both sides of a piece of ordinary cardboard.

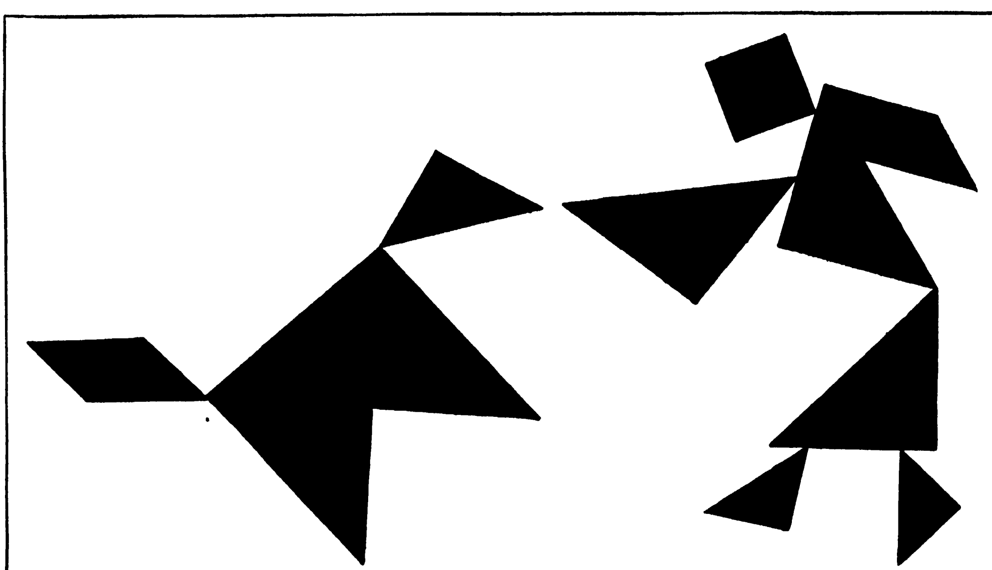
To cut the tangrams we take a square of cardboard of any serviceable size—say, three inches square. We cut with a sharp penknife from C to B. Then we find the middle point of CB, which is E, and we cut from E to D. The remaining pieces are easily cut to the right size, for the various points from and to which we cut are all the middle points of lines. Thus G is the middle point of AB, F of AC, I of FG, J of CE, H of EB. When we have cut up the square as shown, we have seven pieces of cardboard of various sizes—two large triangles, two small triangles, one of medium size, a square and a rhomboid. As you will note, a rhomboid is a four-sided figure containing two sets of parallel lines. The parallel lines are equal to each other but not to the other set of parallel lines; furthermore there are no right angles in the figure.



1. How to cut the tangrams.

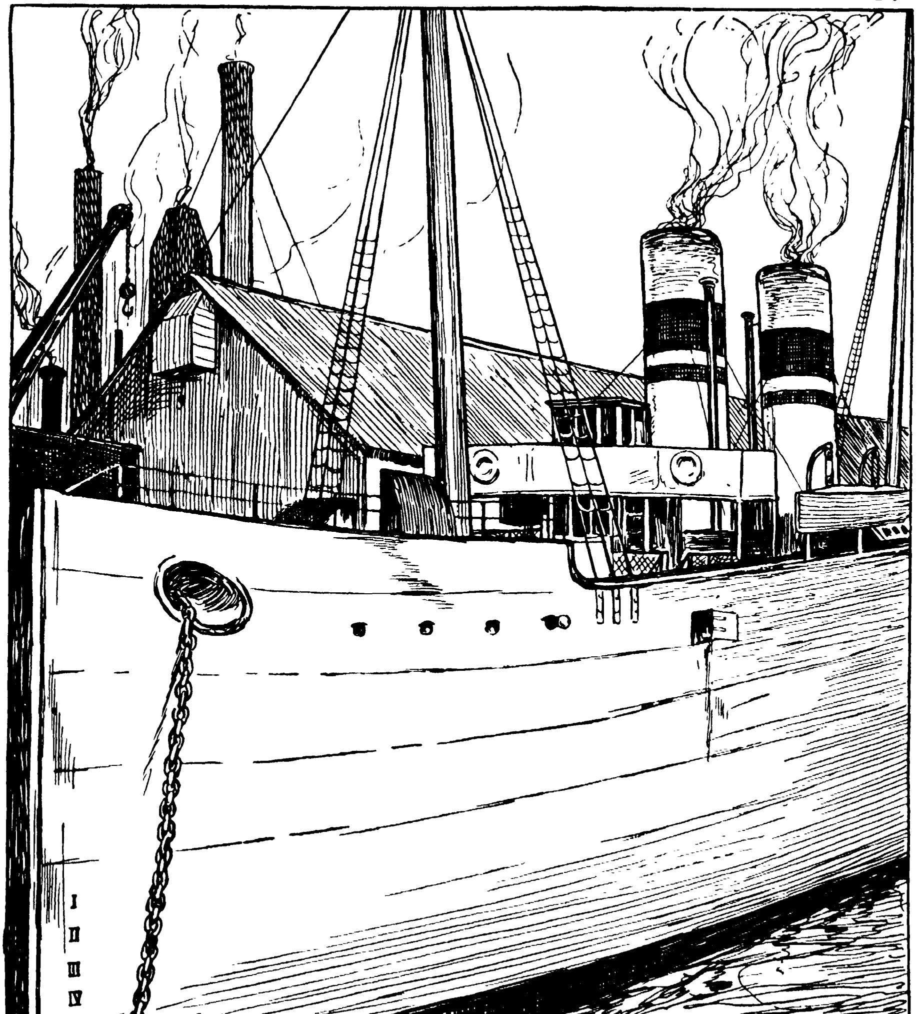
By putting these seven pieces of cardboard together we shall be able to make many different designs—men, animals, birds, fishes, boats, houses, and so on. It must be understood that each picture is to contain the seven pieces of one set—no more, no less. Furthermore, each piece of cardboard must be completely visible.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 4373.



2. Two tangram figures—a girl playing with a dog. Each figure is made up of the seven pieces shown above.

WHAT IS WRONG WITH THIS STEAMER?



When you stand on a busy wharf at a large seaside town you often gaze at the large ships that bring the wheat and the timber and all the wealth of the world for use in all parts of the country. Here is a picture of one of these great steamers, and in making his drawing the artist has made at least ten mistakes. Can you tell where he is wrong? Compare your list with that given on page 4380 of this book.

FAR AWAY AND LONG AGO

Illustrated by Alphonse Bare

The Aztec City

By EUGENE FITCH WARE (1841-1911)

THERE is a clouded city, gone to rest
Beyond the crest
Where cordilleras mar the mystic west.

There suns unheeded rise and re-arise;
And in the skies
The harvest moon unnoticed lives and dies.

And yet this clouded city has no night—
Volcanic light
Compels eternal noontide, redly bright.

A thousand wells, whence cooling waters came,
No more the same,
Now send aloft a thousand jets of flame.

This clouded city is enchanting fair,
For rich and rare
From sculptured frieze the gilded griffins stare.

With level look—with loving, hopeful face,
Fixed upon space,
Stand caryatides of unknown race,

And colonnades of dark green serpentine,
Of strange design,
Carved on whose shafts queer alphabets combine.

And there are lofty temples, rich and great,
And at the gate,
Carved in obsidian, the lions wait.

And from triumphant arches, looking down
Upon the town,
In porphyry, sad, unknown statesmen frown.

And there are palace homes, and stately walls,
And open halls
Where fountains are, with voiceless water-falls.

The ruddy fire incessantly illumes
Temples and tombs,
And in its blaze the stone-wrought cactus blooms.

From clouds congealed the mercury distils,
And, forming rills,
Adown the streets in double streamlet trills.

As rains from clouds, that summer skies eclipse,
From turret-tips
And spire and porch the mobile metal drips.

No one that visited this fiery hive
Ever alive
Came out but me—I, I alone, survive.

Ulysses

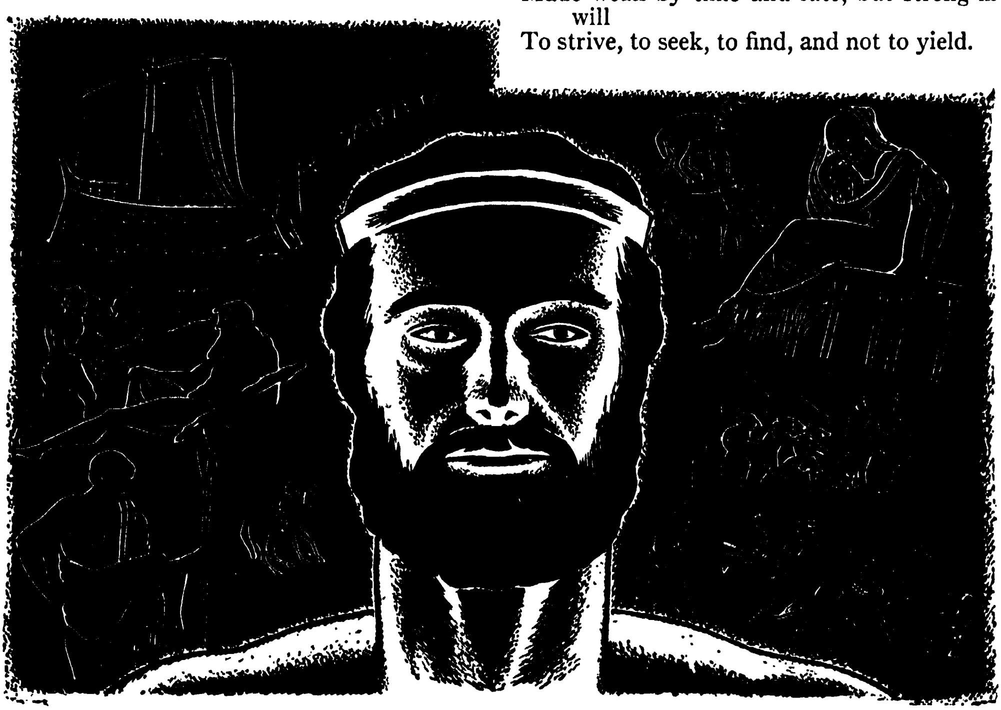
By ALFRED, LORD TENNYSON (1809-1892)

IT LITTLE profits that an idle king,
By this still hearth, among these barren crags,
Matched with an agèd wife, I mete and dole
Unequal laws unto a savage race,
That hoard, and sleep, and feed, and know not me.
I cannot rest from travel: I will drink
Life to the lees. All times I have enjoyed
Greatly, have suffered greatly, both with those
That loved me, and alone; on shore, and when
Through scudding drifts the rainy Hyades
Vexed the dim sea. I am become a name;
For always roaming with a hungry heart
Much have I seen and known,—cities of men
And manners, climates, councils, governments,
Myself not least, but honored of them all;
And drunk delight of battle with my peers,
Far on the ringing plains of windy Troy.
I am a part of all that I have met;
Yet all experience is an arch where through
Gleams that untravelled world, whose margin fades
For ever and for ever when I move.
How dull it is to pause, to make an end,
To rust unburnished, not to shine in use!
As though to breathe were life. Life piled on life

Were all too little, and of one to me
Little remains: but every hour is saved
From that eternal silence, something more,
A bringer of new things; and vile it were
For some three suns to store and hoard myself,
And this gray spirit yearning in desire
To follow knowledge like a sinking star,
Beyond the utmost bound of human thought.

This is my son, mine own Telemachus,
To whom I leave the sceptre and the isle—
Well-loved of me, discerning to fulfil
This labor, by slow prudence to make mild
A rugged people, and through soft degrees
Subdue them to the useful and the good.
Most blameless is he, centred in the sphere
Of common duties, decent not to fail
In offices of tenderness, and pay
Meet adoration to my household gods,
When I am gone. He works his work, I mine.

There lies the port; the vessel puffs her sail:
There gloom the dark, broad seas. My mariners,
Souls that have toiled, and wrought, and thought with me—
That ever with a frolic welcome took
The thunder and the sunshine, and opposed
Free hearts, free foreheads—you and I are old;
Old age hath yet his honor and his toil;
Death closes all: but something ere the end,
Some work of noble note, may yet be done,
Not unbecoming men that strove with gods.
The lights begin to twinkle from the rocks:
The long day wanes: the slow moon climbs: the deep
Moans round with many voices. Come, my friends,
'Tis not too late to seek a newer world.
Push off, and sitting well in order smite
The sounding furrows; for my purpose holds
To sail beyond the sunset, and the baths
Of all the western stars, until I die.
It may be that the gulfs will wash us down:
It may be we shall touch the Happy Isles,
And see the great Achilles, whom we knew.
Though much is taken, much abides; and though
We are not now that strength which in old days
Moved earth and heaven; that which we are, we are;—
One equal temper of heroic hearts,
Made weak by time and fate, but strong in will
To strive, to seek, to find, and not to yield.



Kubla Khan

By Samuel Taylor Coleridge (1772-1834)

In Xanadu did Kubla Khan
A stately pleasure-dome decree;
Where Alph, the sacred river, ran
Through caverns measureless to man
Down to a sunless sea.
So twice five miles of fertile ground
With walls and towers were girdled round:
And there were gardens bright with sinuous rills
Where blossomed many an incense-bearing tree;
And here were forests ancient as the hills,
Enfolding sunny spots of greenery.
But O, that deep romantic chasm which slanted
Down the green hill athwart a cedarn cover!
A savage place! as holy and enchanted
As e'er beneath a waning moon was haunted
By woman wailing for her demon-lover!
And from this chasm, with ceaseless turmoil seething,
As if this earth in fast thick pants were breathing,
A mighty fountain momently was forced,
Amid whose swift half-intermitted burst
Huge fragments vaulted like rebounding hail,
Or chaffy grain beneath the thresher's flail:
And 'mid these dancing rocks at once and ever
It flung up momently the sacred river.
Five miles meandering with a mazy motion
Through wood and dale the sacred river ran,
Then reached the caverns measureless to man,
And sank in tumult to a lifeless ocean:
And 'mid this tumult Kubla heard from far
Ancestral voices prophesying war!
The shadow of the dome of pleasure
Floated midway on the waves;
Where was heard the mingled measure
From the fountain and the caves.
It was a miracle of rare device,
A sunny pleasure-dome with caves of ice!
A damsel with a dulcimer
In a vision once I saw:
It was an Abyssinian maid,
And on her dulcimer she played,
Singing of Mount Abora.
Could I revive within me
Her symphony and song,
To such a deep delight 'twould win me,
That with music loud and long
I would build that dome in air,
That sunny dome! those caves of ice!
And all who heard should see them there,
And all should cry, Beware! Beware!
His flashing eyes, his floating hair!
Weave a circle round him thrice,
And close your eyes with holy dread,
For he on honey-dew hath fed,
And drunk the milk of Paradise.

The New Jerusalem

By William Blake (1757-1827)

And did those feet in ancient time
Walk upon England's mountains green?
And was the holy Lamb of God
On England's pleasant pastures seen?

And did the countenance divine
Shine forth upon our clouded hills?
And was Jerusalem builded here
Among these dark satanic mills?

Bring me my bow of burning gold!
Bring me my arrows of desire!
Bring me my spear! O clouds, unfold!
Bring me my chariot of fire!

I will not cease from mental fight,
Nor shall my sword sleep in my hand,
Till we have built Jerusalem
In England's green and pleasant Land.

Tom O' Bedlam's Song

These verses have come down to us from an unknown poet who lived about or before the time of Shakespeare. Tom o' Bedlam was a name given to half-mad, wandering beggars. Edgar, in Shakespear's King Lear, disguises himself as a Tom o' Bedlam in order to follow and protect the poor outcast king.

FROM the hag and hungry goblin
  That into rags would rend ye,
 And the spirits that stand
 By the naked man
In the Book of Moons, defend ye!

That of your five sound senses
You never be forsaken,
 Nor wander from
 Yourself with Tom,
Abroad to beg your bacon.

The moon's my constant mistress,
And the lonely owl my marrow;
 The flaming drake
 And the night-crow make
Me music to my sorrow.

I know more than Apollo,
For oft, when he lies sleeping,
 I see the stars
 At mortal wars
And the rounded welkin weeping.

With a host of furious fancies,
Whereof I am commander:
 With a burning spear
 And a horse of air
To the wilderness I wander;

By a knight of ghosts and shadows
I summoned am to tourney:
 Ten leagues beyond
 The wide world's end;
Methinks it is no journey.

Romance

By WALTER J. TURNER (1889-

WHEN I was but thirteen or so
 I went into a golden land,
Chimborazo, Cotopaxi
 Took me by the hand.

My father died, my brother too,
 They passed like fleeting dreams.
I stood where Popocatapetl
 In the sunlight gleams.

I dimly heard the master's voice
 And boys far-off at play,
Chimborazo, Cotopaxi
 Had stolen me away.

I walked in a great golden dream
 To and fro from school—
Shining Popocatapetl
 The dusty streets did rule.

I walked home with a gold dark boy,
 And never a word I'd say,
Chimborazo, Cotopaxi
 Had taken my speech away:

I gazed entranced upon his face
 Fairer than any flower—
O shining Popocatapetl
 It was thy magic hour:

The houses, people, traffic seemed
 Thin fading dreams by day,
Chimborazo, Cotopaxi,
 They had stolen my soul away!

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Carcassonne

Translated by JOHN R. THOMPSON *from the French of Gustave Nadaud*

"I'M GROWING old, I've sixty years;
I've labored all my life in vain.
In all that time of hopes and fears,
I've failed my dearest wish to gain.
I see full well that here below
Bliss unalloyed there is for none;
My prayer would else fulfilment know—
Never have I seen Carcassonne!

"You see the city from the hill,
It lies beyond the mountains blue;
And yet to reach it one must still
Five long and weary leagues pursue,
And, to return, as many more.
Had but the vintage plenteous grown—
But, ah! the grape withheld its store.
I shall not look on Carcassonne!

"They tell me every day is there
Not more or less than Sunday gay;
In shining robes and garments fair
The people walk upon their way.
One gazes there on castle walls
As grand as those of Babylon,
A bishop and two generals!
What joy to dwell in Carcassonne!

"The vicar's right: he says that we
Are ever wayward, weak and blind;
He tells us in his homily
Ambition ruins all mankind;
Yet could I there two days have spent,
While still the autumn sweetly shone,
Ah, me! I might have died content
When I had looked on Carcassonne.

"Thy pardon, Father, I beseech,
In this my prayer if I offend;
One something sees beyond his reach
From childhood to his journey's end.
My wife, our little boy, Aignan,
Have travelled even to Narbonne;
My grandchild has seen Perpignan;
And I—have not seen Carcassonne!"

So crooned, one day, close by Limoux,
A peasant, double-bent with age.
"Rise up, my friend," said I; "with you
I'll go upon this pilgrimage."
We left, next morning, his abode,
But (Heaven forgive him!) half-way
on
The old man died upon the road.
He never gazed on Carcassonne.

Romance

By ANDREW LANG
(1844-1912)

MY LOVE dwelt in a Northern land.
A gray tower in a forest green
Was hers, and far on either hand
The long wash of the waves was seen,
And leagues and leagues of yellow sand,
The woven forest boughs between!

And through the silver Northern night
The sunset slowly died away,
And herds of strange deer, lily-white,
Stole forth among the branches gray;
About the coming of the light,
They fled like ghosts before the day!

I know not if the forest green
Still girdles round that castle gray;
I know not if the boughs between
The white deer vanish ere the day;
Above my Love the grass is green,
My heart is colder than the clay!

Glycine's Song

By SAMUEL TAYLOR COLERIDGE
(1772-1834)

A SUNNY shaft did I behold,
From sky to earth it slanted:
And poised therein a bird so bold—
Sweet bird, thou wert enchanted!

He sank, he rose, he twinkled, he trolled
Within that shaft of sunny mist;
His eyes of fire, his beak of gold,
All else of amethyst!

And thus he sang: "Adieu! adieu!
Love's dreams prove seldom true.
The blossoms, they make no delay:
The sparkling dew-drops will not stay.
Sweet month of May,
We must away;
Far, far away!
Today! today!"

Spanish Waters*

By John Masefield (1878-   )

Spanish waters, Spanish waters, you are ringing in my ears,
Like a slow sweet piece of music from the gray forgotten years;
Telling tales and beating tunes, and bringing weary thoughts to me
Of the sandy beach at Muertos, where I would that I could be.

There's a surf breaks on Los Muertos, and it never stops to roar,
And it's there we came to anchor, and it's there we went ashore,
Where the blue lagoon is silent amid snags of rotting trees,
Dropping like the clothes of corpses cast up by the seas.

We anchored at Los Muertos when the dipping sun was red,
We left her half a mile to sea, to west of Nigger Head;
And before the mist was on the cay, before the day was done,
We were all ashore on Muertos with the gold that we had won.

We bore it through the marshes in a half-score battered chests,
Sinking, in the sucking quagmires, to the sunburn on our breasts,
Heaving over tree trunks, gasping, damning at the flies and heat,
Longing for a long drink, out of silver, in the ship's cool lazareet.

The moon came white and ghostly as we laid the treasure down,
There was gear there'd make a beggarman as rich as Lima Town,
Copper charms and silver trinkets from the chests of Spanish crews,
Gold doubloons and double moidores, louis d'ors and portagues,

Clumsy yellow metal earrings from the Indians of Brazil,
Uncut emeralds out of Rio, bezoar stones from Guayaquil;
Silver, in the crude and fashioned, pots of old Arica bronze,
Jewels from the bones of Incas, desecrated by the Dons.

*From Poems, by John Masefield, by permission of the publishers, The Macmillan Company.

We smoothed the place with mattocks, and we took and blazed the tree,
Which marks yon where the gear is hid that none will ever see,
And we laid aboard the ship again, and south away we steers,
Through the loud surf of Los Muertos which is beating in my ears.

I'm the last alive that knows it. All the rest have gone their ways,
Killed, or died, or come to anchor in the old Mulatas Cays,
And I go singing, fiddling, old and starved and in despair,
And I know where all that gold is hid, if I were only there.

It's not the way to end it all. I'm old, and nearly blind,
And an old man's past's a strange thing, for it never leaves his mind.
And I see in dreams, awhiles, the beach, the sun's disc dipping red,
And the tall ship, under topsails, swaying in past Nigger Head.

I'd be glad to step ashore there. Glad to take a pick and go
To the lone blazed coco-palm tree in the place no others know,
And lift the gold and silver that has mouldered there for years
By the loud surf of Los Muertos which is beating in my ears.

The Lotos-Eaters

By Alfred, Lord Tennyson (1809-1892)

"Courage!" he said, and pointed toward the land,
"This mounting wave will roll us shoreward soon."
In the afternoon they came unto a land
In which it seemèd always afternoon.
All round the coast the languid air did swoon,
Breathing like one that hath a weary dream.
Full-faced above the valley stood the moon;
And, like a downward smoke, the slender stream
Along the cliff to fall and pause and fall did seem.

A land of streams! some, like a downward smoke,
Slow-dropping veils of thinnest lawn, did go;
And some through wavering lights and shadows broke,
Rolling a slumberous sheet of foam below.
They saw the gleaming river seaward flow
From the inner land: far off, three mountain-tops,
Three silent pinnacles of agèd snow,
Stood sunset-flushed; and, dewed with showery drops,
Up-clomb the shadowy pine above the woven copse.

The charmèd sunset lingered low adown
In the red West: through mountain clefts the dale
Was seen far inland, and the yellow down
Bordered with palm, and many a winding vale
And meadow, set with slender galingale;
A land where all things always seemed the same!
And round about the keel with faces pale,
Dark faces pale against that rosy flame,
The mild-eyed melancholy Lotos-eaters came.

Branches they bore of that enchanted stem,
Laden with flower and fruit, whereof they gave
To each, but whoso did receive of them
And taste, to him the gushing of the wave
Far, far away did seem to mourn and rave
On alien shores; and if his fellow spake,
His voice was thin, as voices from the grave;
And deep-asleep he seemed, yet all awake,
And music in his ears his beating heart did make.
They sat them down upon the yellow sand,
Between the sun and moon upon the shore;
And sweet it was to dream of Fatherland,
Of child, and wife, and slave; but evermore
Most weary seemed the sea, weary the oar,
Weary the wandering fields of barren foam.
Then someone said, "We will return no more";
And all at once they sang, "Our island home
Is far beyond the wave; we will no longer roam."

THE NEXT POEMS ARE ON PAGE 4343.

What Makes Water Gurgle When It Comes Out of a Bottle?

WE know that air has pressure, so if there is an empty space anywhere, the air will press into it. Now, when we pour water out of a bottle that is full, there must be an empty space left behind in the bottle when the liquid comes out, and from moment to moment, as that empty space tends to be formed in the bottle, the air outside is bound to rush in to take its place. If the bottle has a wide mouth, the air can flow in evenly, and there is no gurgling.

But if we take a full ginger-ale bottle, and hold it upside down, then there is a series of fights going on between the liquid that is trying to get out under the pull of gravitation and the air that is trying to push its way past the liquid to fill up the space in the bottle. Sometimes the air pushes back the ginger ale, and sometimes the ginger ale pushes back the air. This means that the air is thrown into little disturbances, which we hear as gurgles. When we pull a cork out of a botttle of bubbling liquid, the rush of air then makes a "pop."

WHY IS A RED-AND-WHITE POLE BEFORE A BARBER SHOP?

Long ago in Europe the barber was often called the barber-surgeon, and performed many small surgical operations, as well as shaving and cutting or dressing hair. Until about a hundred and fifty years ago it was generally believed that many illnesses could be cured by opening a vein and drawing a quantity of blood. This operation was known as bleeding, and was usually done by the barber-surgeon. Before the barber's shop was hung a red pole with a bowl and a white strip of cloth hanging from it. The red represented the blood that was to be caught in the bowl, and the cloth the bandage. The old symbol of a pole with red and white stripes still stands before the barber's shop.

Napoleon bestows the first Legion of Honor badges.

WHAT IS THE LEGION OF HONOR?

Most of the countries of the world give special honor to subjects or citizens who distinguish themselves in war or learning or artistic or other achievement, by conferring upon them membership in a special society. Some of these societies are orders of knighthood, like the Order of the British Empire. Within each order there are usually grades or steps and a man can be raised from the first grade to a higher one by further distinguishing himself.

When France became a republic, all her orders of nobility were swept away. But before long Napoleon saw the need for a suitable method of honoring outstanding soldiers and others who served the state. So he formed a new order, calling it the Legion of Honor; and that is today the only order of France. There are grades of membership within it and the higher grades, those of Commander, Grand Officer and Grand Cross, are as much esteemed as any other orders in the world. Women have several times been admitted to membership, notably Rosa Bonheur and Madame Curie.

Some memberships carry salaries, and daughters, granddaughters, nieces and sisters of members may receive free educational advantages if their parents are not able to provide for them.

WHAT IS BALANCE OF TRADE?

In the somewhat simpler world before 1914, a country regarded itself as prospering if its sales to other countries amounted to more money than its purchases from abroad. In other words, more exports than imports gave a country a margin of money. This excess of exports over imports is called a favorable balance of trade.

This is easily understood if you think of a farmer with a big family, some of whom raise crops, some make shoes, others can vegetables and fruits, weave cloth and dig lead or another metal from a hole in the five-acre lot. They sell their products for about $100,000 each year.

They must buy automobiles, machinery to work with, some of their clothes, books and other articles, amounting to $97,000 a year. They have a favorable balance of $3,000.

A country's balance of trade is not, however, made by simply balancing actual goods exported and imported. There are exports and imports that can not be measured by weight or dimension. We call them invisible items of trade, but they are none the less real. For example, money that we spend as tourists in a foreign country must be figured with our imports, also passage money and freight charges in foreign ships.

Another thing that must be considered is that countries will not buy without selling, unless the selling country has a monopoly of a product. Brazil, for instance, is able to maintain a strong favorable trade balance because she has almost a world monopoly of coffee, a commodity that many other countries use in great quantities yet can not grow for themselves.

Similarly, countries make trade agreements between themselves so that they may have in advance some idea of what buying and selling will be done, and where. A highly favorable balance of trade to one country may be bad for the world, and in the end would be bad for the country itself. The buying countries, with little or no money coming in, would soon become too poor to buy more. The selling country would then find itself with a stock of goods on hand, and no customers. Co-operation is wiser than selfishness, which most of the world's nations are slowly but surely learning.

Social Security Administration—Black Star
Where a social-security check means the difference between accepting charity and keeping one's pride.

WHAT IS SOCIAL SECURITY?

One of the most serious problems facing all states is the care of those who for one reason or another are unable to care for themselves. In the past the care of the needy was often left to the charity of private individuals or institutions. When the state did intervene, its efforts were often half-hearted; often, too, disgrace and suffering were the lot of the individuals who were helped. One need only recall so many of the public hospitals, insane asylums, orphanages and poorhouses of the past.

Of late, however, the idea has grown in many countries that the protection of the individual is not a matter that should be left to private charity. According to this viewpoint, the government should take it upon itself to guard the welfare of all its citizens, not as an act of charity but as a duty, not only in health but also in illness, need and old age. In other words, the state should concern itself with the social security of its citizens.

To advance this ideal, the United States Congress passed the Social Security Act on August 14, 1935. This act provides for co-operation between the Federal Government and the states in establishing 1) old age pensions, 2) unemployment insurance, 3) care for the dependent, the needy and the blind, 4) public-health measures and a number of other things besides.

WHY ARE NOT ALL DISEASES INFECTIOUS?

What we call infection may be due to the presence of a vast number of tiny living cells called germs or bacteria, or it may be caused by still smaller units called viruses. The bacteria are so small that it requires very high magnifying powers in a microscope to see them, and some viruses are too small to be seen even under a microscope. By the action of bacteria or viruses on the living tissues of plants and animals many diseases are produced. The germs and viruses are so small and so light that they can be carried about in the air or they may get into the water. They may contaminate the atmosphere or our food, and so spread disease wherever they go. That is what is meant by carrying infection. For instance, the germs that cause typhoid fever or diphtheria often get into a milk supply or a water supply, and so cause an epidemic among the people who use that source of drinking water or milk.

There are many diseases that are not infectious, because they are not caused by germs or viruses. For instance, some diseases are due to various chemical substances that act as poisons upon the tissues of the body. Some diseases come from the fatigue of certain organs, such as the heart. All these concern only the individual, and are not transmitted to other persons, as are the diseases caused by bacteria and viruses.

WHAT IS MEANT BY BALANCE OF POWER?

A number of countries can live together in peace and harmony just as long as no one of them, nor any group of them, becomes so rich and powerful that it tries to interfere with the others. One very strong state or group bent on peace can keep the peace even when there are two opposing warlike nations. The peaceful country can swing its strength, first toward one side, then toward the other. Such a nation is said to hold the balance of power. England has more than once in her history served as such a balance. In the nineteenth century alliances between coun-

tries served for a while, but the European alliances could not prevent the breakout of World War I. After that war, the League of Nations, which was almost a world alliance, strove to keep peace. Then came World War II, and out of it a more powerful alliance, the United Nations. Thus, in a century, the old idea of balance of power has given way to the belief that the world can solve its problems without war, or threat of war. See United Nations, in the Index.

WHAT IS SABOTAGE?

Sabot is the French word for a certain kind of heavy shoe, sometimes made of wood. When you learn that sabotage means the willful and malicious destruction, by discontented workers, of a factory, or of tools, machinery or goods, you will wonder how such an act came to have any connection with shoes. Several explanations are offered. One is that strikers in the middle of the nineteenth century threw their shoes into machinery, to cripple it; another is that they kicked the machinery until it was thrown out of working order. An historical case of sabotage in which shoes were actually concerned occurred in 1912 during a large railway strike in France. Some of the strikers cut the sabots or shoes holding the railway tracks, so that the trains, if they were run over the lines, would be wrecked.

In World War II sabotage was widely used, in France and other conquered countries, as a protest against nazi rule. Workers in armament factories slowed down their efforts, and even made war materials that were defective so that they soon fell apart. We shall never know just how much sabotage cost the nazi war machine.

WHAT DO WE MEAN BY ADULT EDUCATION?

If we stop learning when we stop going to school, we shall never be very wise. The man or woman who continues to gain knowledge all through life has learned one of the secrets of success.

Of course very few adults can afford to stay at school all day long, and so their hours of study must cut into their hours of

Grandfathers and grandmothers keep their minds young and alert with the study of new facts and new ideas.

play. But adult education has been made so interesting that study has become, for many adults, a very absorbing sort of recreation.

Adult education is carried on in a variety of ways. It is possible to study in one's own home, either by following a definite reading plan or else by taking correspondence courses from a school or college or university. The radio may also be used in connection with home study.

But perhaps adults may prefer actual class work. Many cities have provided classes for adults in a variety of subjects. Colleges and universities have entered this field too, and a number of them offer what they call extension courses for adults.

WHAT ARE THE GROOVES ROUND A COIN FOR?

Pennies and nickels have smooth edges, but silver and gold coins are milled, as we say, round the edge. The reason is that people used to pare the edges of coins, especially gold coins, and then sell the precious metal. This was, of course, stealing the nation's money; and the best way of stopping it was found to be milling the edges of the more valuable coins, so that no one could pare them without letting it be seen at once. Copper and nickel coins are not milled because it would not be worth while.

WHY DOES STARCH STIFFEN CLOTHES?

Starch is a very curious chemical compound, with its own way of behaving. When mixed with water, we can scarcely say that it really dissolves, certainly not as sugar and salt dissolve. But it forms a sort of "gravy" with water, and when the water evaporates the starch is left behind. When clothing is dipped in starch, the starch forms a sort of stiff layer on the cloth.

HOW DOES A BILL BECOME A LAW?

The words bill and law (or act) are often confused in common speech, but really they are quite different. In a legislative body a bill is a proposal to do or to prohibit something. Not until it has been approved by the body and, usually, has received the signature of the executive, does it become an act or a law. The process is not quite the same everywhere. Some legislative bodies have two houses, others only one; some executives have the veto power, others do not. Generally in a country or division of a country in which there are two houses, the process is something like that described herewith.

A bill in writing is introduced in one house. Generally it is referred to a committee, which discusses it and may report it back to the house unchanged, either favorably or unfavorably; or it may report it back with amendments. It is then discussed on the floor and may be still further amended. If approved the bill goes to the second house, where it is again referred to a committee, which has the same power as the committee of the other house. The bill is discussed on the floor of the second house and a vote is taken. If the bill has not been changed by the second house it goes to the executive for his signature. If it has been amended in the second house it goes back to the first house. If this house agrees to the change or changes it then goes to the executive. If the first house does not agree to the changes, generally a conference committee is appointed with members from both houses, which may come to an agreement. This agreement is submitted to both houses, and, if it is approved, the amended bill then goes to the executive, for his signature.

In countries where the executive has no veto power, he signs as a matter of course. When the executive has the veto power it may be absolute or limited. In the few countries where the veto power is absolute nothing further can be done if the executive refuses to sign the bill. Where the veto power is limited, as in the United States and in most of the separate states, the process is as follows. The executive returns the bill, with his objections, to the house in which it originated. A vote is then taken and if a majority —two-thirds in most cases—still thinks the bill should become a law, it then goes to the other house. If there it receives a like majority it becomes a law without the signature of the executive. To prevent an executive from killing a bill by doing nothing, most constitutions provide that unless a bill is signed or returned within a given number of days it becomes a law without the signature of the executive.

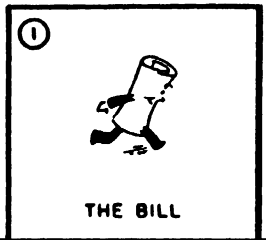
By the terms of the British North America Act the governor-general of Canada and the lieutenant-governors of the provinces had the power to disallow (veto) certain classes of bills. With the changed position of Canada in the Commonwealth of Nations this power is no longer exercised. While, in theory, the king of England has the veto power, it has not been exercised in more than two hundred years.

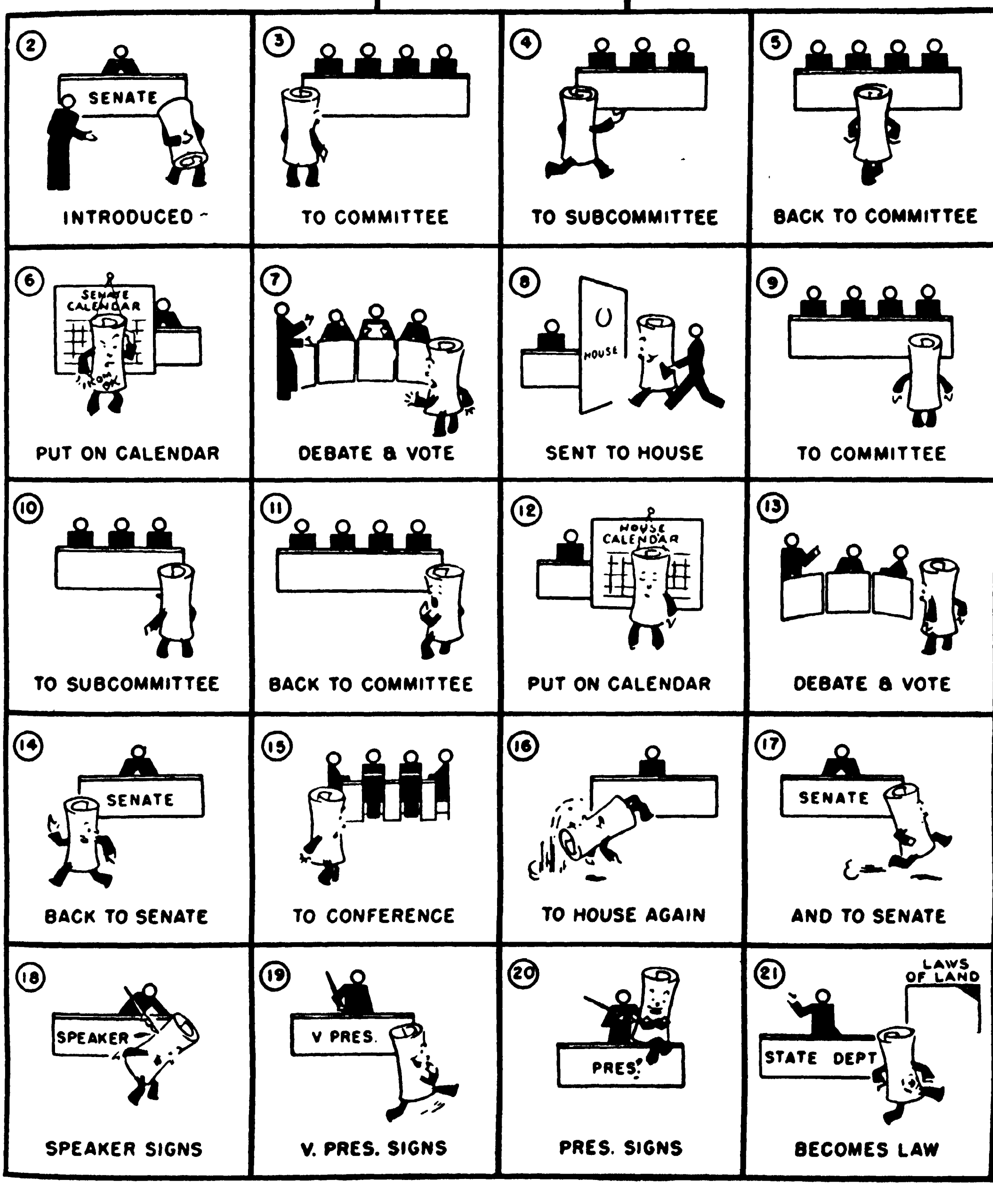
THE NEXT WONDER QUESTIONS ARE ON PAGE 4321.

HOW A BILL BECOMES A LAW

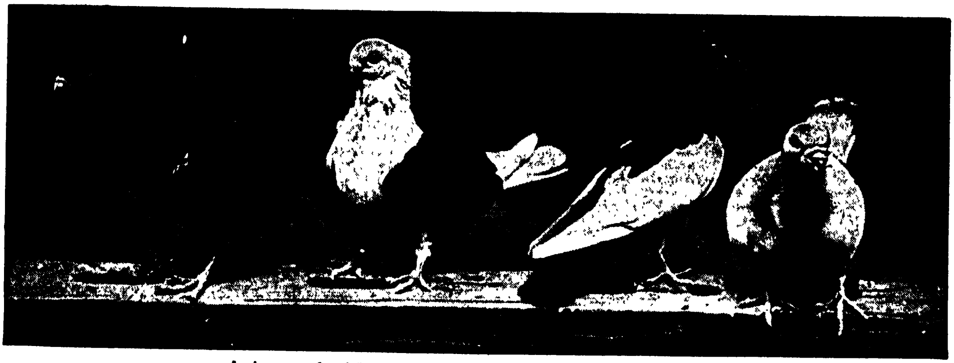
This is the long journey a bill must take through Congress before it becomes a law of the land. In the course of its travels it may be changed considerably, so that the final bill that becomes a law may be very different from the bill as it was introduced originally. The whole process is very complicated.

Chart by Kermit Johnson in Weekly News Review, Washington, D. C.

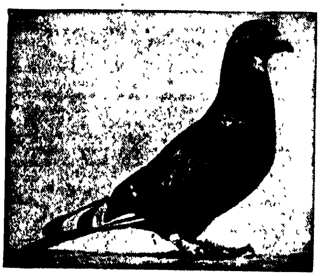




A FLOCK OF PIGEONS

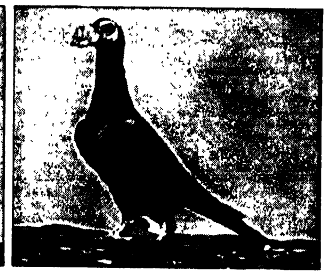


Antwerp, short-billed turbit, magpie and blue owl pigeons.



The homing pigeon.

The pouter pigeon.



The carrier pigeon.

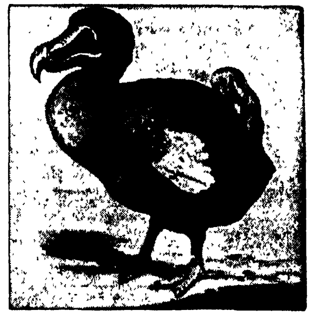
Short-faced tumblers.

Fantail pigeons.

Homing pigeons at rest outside their loft.


The Solitaire.


The Passenger Pigeon.


The Dodo.

THREE MEMBERS OF THE PIGEON TRIBE THAT HAVE NOW BECOME EXTINCT

THE PIGEONS AND THE DOVES

OVER the heart of a crowded city a bird comes swiftly flying, winds beating on it, smoke dimming its route, the noise of traffic and industries rising about it in seas of sound, terrifying and unnatural. Spires of churches, tall fuming chimneys of factories, miles of single-patterned roofs, scores of miles of streets, one like another as seen from the skies, are spread below the winged explorer.

The bird braves the wind, endures the smoke, ignores the crash and uproar ascending from the Babel; passes heedless over all streets save one, over all roofs but that which covers a poor house in a side street. And there, on the landing-board of a little cot nailed beneath the eaves, it alights and struts inside in urgent haste.

A homing pigeon has reached its house, the tiny dwelling set up for it by the creature who has become its lord, that tamer of wild things—the boy in threadbare breeches who sets aside his few weekly pennies to buy grain for the bird which is his very own.

Our little man repeats by his mother's knee at night the lesson he has learned by day from Genesis. Does he realize, we wonder, that this homing of his aerial treasure is a reproduction of the first recorded act of co-operation between man and the lower creation?

The dove which returned to the Ark, bearing in its mouth the olive leaf it had plucked as a sign that the Flood had abated, was a pigeon; and the pigeon which wings its way in a dingy alley is a dove.

Our Anglo-Saxon forefathers called all the birds of this kind doves. We still use that name, but pigeons and doves are all one family, grouped in tribes and spread far and near about the earth. They are not to be found in Polar country simply because there is no pigeon food there, or the courage and hardihood of the birds would make a place for them there. They are vegetarians and eat immense quantities of grain and seeds. Nowadays cultivated fields count certain breeds of pigeons among the determined enemies of husbandry.

But the species number scores, even hundreds, not including the dozens of varieties of the domestic group beloved of fanciers. The family is gifted with such powers of flight and self-protection, and its numbers increase so rapidly, that at first sight we might think that the *Columbæ* family, to use its scientific name, is the most favored of feathered adventurers. But every rule has its exceptions, and three of the most notable of birds have vanished from this grand group. Man is responsible for each.

THE SAD END OF TWO BIRDS THAT LOST THE POWER OF FLIGHT

The Dodo and the Solitaire were both members of the family which have disappeared. There never can have been more clownish birds than these which lived in the peaceful mystery of the islands of Mauritius, Réunion and Rodriguez. The dodo was a plump and ponderous creature, swan-sized in body, but its wings, dwarfed by age after age of inaction, left their owner with as little idea of flight as a penguin. The solitaire was longer of leg and neck, and, like its cousin, a caricature. They were both simply exaggerated pigeons which had lost the power of flight.

Men found the dodo in 1598, and in a century had exterminated it. The solitaire survived in hiding in its native wilds, scarcer and scarcer, till the second half of the eighteenth century; then its career closed forever. We would give a fortune for a pair of either of these birds, but all the dodos and all the solitaires marched to doom down hungry, heedless sailors' throats.

THE WONDERFUL MIGRATIONS THAT ARE SEEN NO MORE

Until recently a writer on natural history, seeking an illustration of the matter of numbers in life, turned for a never-failing source of data to the marvelously numerous Passenger Pigeons of America. One could quote pictures of the birds during their migrations in search of nesting sites and food filling the air so that the sun was obscured for hours by their flocks, miles and miles in extent, speeding day after day to the chosen sites.

> The approach of the mighty feathered army with a loud rushing roar and a stirring breeze, attended by a sudden darkness, might be mistaken for a fearful tornado about to overwhelm the face of Nature. For several hours together the vast host, extending some miles in breadth, still continues to pass in flocks without diminution. The whole air is filled with birds, their muting resembles a shower of sleet, and they shut out the light as if it were an eclipse. At the approach of the Hawk their sublime and beautiful aerial evolutions are disturbed like the ruffling squall extending over the placid ocean; as in a thundering torrent they rush together in a concentrating mass, and bearing in undulating and glittering sweeps towards the earth, at length again proceed in lofty meanders like the rushing of a mighty animated river. (Nuttall's Birds of the United States.)

What the yearly massing of the countless springboks among antelopes represented in mammalian life these annual troopings of the passenger pigeons represented among birds. A single nesting colony claimed every tree in the forests extending over an area twenty-eight miles long and from three to four miles wide. Each tree teemed with nests, so that as eggs gave rise to young pigeons the weight was often too much for a mighty branch to bear, and, in the words of our old song, "down would come babies, cradles, and all."

It was a sum of life expressed in millions and millions and yet millions of flying birds. Men multiplied in the wake of the passenger pigeons, and slew them from year to year with such unpitying greed and folly that the unparalleled swarms were thinned and thinned until fugitive flocks became straggling units, and, as we have seen, the very last passenger pigeon of all that uncountable multitude perished, the precious exhibit of the Cincinnati Zoölogical Park in the year 1914.

THE BLUE-ROCK WILD PIGEONS AND THEIR MANY KINDS OF DESCENDANTS

Such tragedies leave an ache in the mind of a student of these delightful creatures. For the credit of our kind, let us remember that man has helped to create as well as to destroy. We have eaten out of life three entire kinds of pigeon; but we have brought into being many times that number. Every one of our domestic breeds is believed to have been developed by man from the Blue-rock, a European pigeon which seems wild and untamable. Nevertheless, from it our pets have come as the result of years of selection and careful breeding.

A bird which returns to its home from a distance of hundreds of miles has the blue-rock spirit. The Fantail, white as snow, proud as a peacock as it struts and sprawls on the roof, is a changed blue-rock. The great Pouter, with his crop puffed up with air and insolence, and his legs and feet feathered as in bell-bottomed nankeen trousers, is of the same line. So are the picturesquely ugly Dragon and Carrier, with their bare, warty heads, looking as if they had thrust their beaks through clusters of fleshy mushrooms.

The Tumblers, which reel like acrobats in their midair play; the Highfliers, which keep the air in unwearying circles, displaying their mottled, pearly loveliness in the sunlight for eight hours at a time

without a descent for rest; the little Almond Faces, with their absurdly pretty short beaks; the long-faced, grim Scanderoons; the Jacobins, hooded in mysterious mantle and ruffle; the Turbits, with beaks like two cauliflower seeds set together, and with feathers folding like refractory petals on their breasts; the Trumpeters, sweet of note but muffled about the head with feathers like a Skye terrier with hair, and feathered about the legs like a shire horse with hair—these are simply fixed varieties to which careful selection by successive generations of breeders has brought the descendants of the blue-rock.

The perfect adaptability of the wolf and jackal to the conditions of human society has given us a multitude of breeds of dogs in our midst; the adaptability of the widespread blue-rock pigeon has given us hosts of tamed birds, many of them now incredibly unlike their free ancestors.

One has records of pigeons and doves living between twenty and thirty years, and a safe average is fifteen years.

THE HOMING PIGEON AS A COURIER FOR THE GREEKS OF OLD

Each breed has its admirers, and we are all secretly convinced that our own favorite is the best and the breeds of our rivals not quite worthy of our skill and affection. That is as it should be. But we all meet on common ground when we render tribute to the Homing Pigeon. The homing pigeon is the king of all the pigeon tribes we love. For clean-cut beauty none of the fancy domestic varieties we cherish can compare with the homer.

If ever a bird looked its part, this is the one. Everything in its make-up implies strength and swiftness; there is no fanciful feathering of the lower legs or feet, no pride-swollen pouch, no hooded eyes, no unlovely wattles to offer resistance to the air. A homer is as perfectly fashioned as we should make an airplane if we could, yet the homer is the nearest in design and coloring to the shy blue-rock.

These homing birds have made history. They were the swiftest of all messengers until electricity outran them. When Greece was the nursing mother of culture and the mistress of wondrous empires it was the homing pigeon by which she sent her news, sounded her alarums, wailed her defeats, trumpeted her victories. The names of victors in the Olympic Games were sent to every city by pigeon post.

THE LITTLE WINGED STEEDS IN PEACE AND WAR

From that day to this the homers have been man's couriers of the air. The messenger-bird has its message written on thin paper inclosed in a tiny quill attached to its leg; the racer, set free in strange territory, has its goal in a nest of straw in some remote pigeonry. Both rush through the troubled air with their own speed added to that of a gale which favors, or fight against a gale which opposes them.

Their speed in still air is thirty or forty miles an hour; a friendly wind lends its own pace as an addition to theirs; a hostile wind subtracts. With a velocity like this our pigeons might visit the shores of Europe in less than three days. Associated with the swiftness of flight is extraordinary keenness of vision, or otherwise the object of its motions might be lost. Thousands are interested in these birds. What the Arab steed is to the horse-loving son of the desert the faithful homing pigeon is to the townsman and villager who nurture and train these birds.

THE POWERFUL MUSCLES THAT ARE LIKE A LIVING MOTOR

The power of flight comes not only from the wings, but from the immense muscles of the breast—living motors for the pinions. This mass of muscle on a pigeon's breast amounts to a quarter of the entire weight of the bird.

In one respect these creatures remind us of the ruminants, the animals which chew the cud. They can gorge their great elastic crops with a weight of food actually greater than the weight of their bodies, fly far away to safety, and rest while the tough membranes of the gizzard, or stomach, aided by grit and stone, grind the hard grain to pulp.

There is a wonder of production in that crop of the pigeon. When the parent birds have young ones in the nest the crop glands become enlarged and secrete a nutritious fluid which we call pigeon's milk. On that the babies are fed till they are old enough to accept grain.

Even when that stage is reached, however, the youngsters are not fed with the food in its natural condition. The old birds swallow it, soften it, and add fluid to it, and then, putting the beaks of the squeaking nestlings into their own pump the half-digested grain down their

throats. The writer has from time to time brought up by hand orphaned little pigeons, feeding them on soaked corn. The young ones responded to the treatment, but when mature they never matched the size and strength of those naturally reared.

THE MYSTERY OF THE BIRD THAT DRINKS LIKE A HORSE

Such birds live on, and mate, and reproduce their kind, and suggest that from their like we might evolve a dwarfed variety of pigeons. But for the divergence from the normal among the untamed species it is not so easy to account. Many a chapter of mysterious evolution is hidden in the little things and great which distinguish one species of pigeon from another species and from all the rest. How interesting it would be to discover how pigeons learned to drink differently from other birds!

They suck up their fluid like a horse, and satisfy themselves at one draft. Such a method of drinking in time and position of peril must be a most valuable asset to a bird, and the trait must many a time have turned the scale in favor of life when to pause long over drinking in the neighborhood of danger would have meant death.

In physical features, too, there are differences impossible to explain. There must be a definite advantage in the short legs and broad soles of the feet of the Wedge-tailed Green Pigeons, or we should not find such great numbers of these birds in Africa, sunny Asia and the warm islands of the ocean. What is the corresponding peculiarity of the Walia Pigeons of Abyssinia? It is not revealed to the eye. The fact that these birds flourish exceedingly in a subtropical area, rarely less than 2,000 feet above sea-level, and never more than 6,000 feet up, shows that appetite has determined their prosperity. They are fruit-eaters, and their home teems with wild figs, so there in the midst of them are the Walia pigeons. About half the pigeons belong to the fruit-eaters.

SOME BEAUTIFUL MEMBERS OF THE GREAT PIGEON FAMILY

Then we have a number of green species in southeastern Asia and the Malay Archipelago, much like the Thick-billed Green Pigeons, yet not of their group. They are closest kin of the type species, the green pigeon, which belongs especially to Malabar, and so take the specific name from that one. This group has not the Malay Archipelago as a private hunting-ground, for the Painted Pigeons which gladden the eyes of nature-loving Australians are there too. Seemingly only a step in structure from the green pigeons, they are smaller but gem-like in their feathering.

Many of them possess an extravagant luxury of beauty. All the colors of the rainbow go to adorn them, always harmoniously combined. The softest lilac, silvery gray tones, blue as a Mediterranean sky, golden shadings, deep-sea green, red, purple, bronze, shimmering steel gray—these are the tones in which Nature has delighted to paint these fair children of hers. It is a poor pigeon which does not carry a metallic sheen on its handsome graceful neck; but the painted darlings of the tribe have lustre and loveliness combined in such measure as to charm the eye as music and poetry charm the intellectual senses.

THE DOVE THAT MAKES ITS HOME IN A RABBIT BURROW

The Golden Pigeons are as splendid in a less varied color-scheme, and there is gracious coloring, too, in the Wart Pigeons. Nor is beauty denied to the many species of Fruit-pigeons, of which the Nutmeg Pigeon is peculiar as having only one egg to a nest.

So far we have dealt with the tropical species among the wild ones, but now we must glance at more typical examples, headed by that wonderful ancestor of multitudes, the rock-dove, or blue-rock pigeon, already named. Though most wild pigeons build nests in trees, the European Stock-dove has the habit of making its home in rabbit burrows when the soil is light and sandy, or crouching like a pheasant beneath a bush.

The European Wood-pigeon, or Ring-dove, however, is true to family traditions in making its nest high up in the trees. This bird is the largest of European wild species. Only the domestic Runt, a monster of the home dovecote, compares in size with it. Recently wood-pigeons have taken up their residence in London and appear to grow larger than in the country.

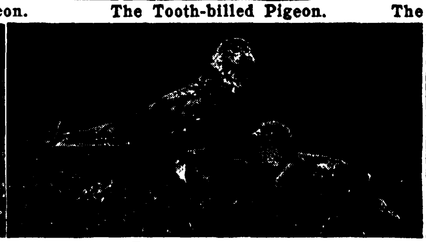
In the country, however, the wood-pigeon is a brigand much hated by the farmers. Two things are against it—its vulture-like appetite and its overwhelming numbers. It does enormous good in eating multitudes of injurious seeds; but

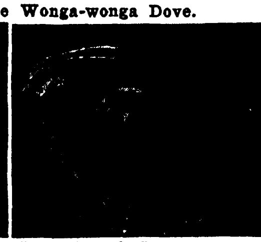

The Crowned Pigeon.

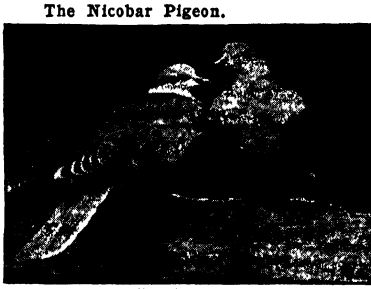

The Tooth-billed Pigeon.

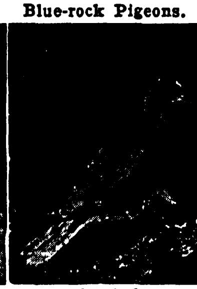

The Wonga-wonga Dove.

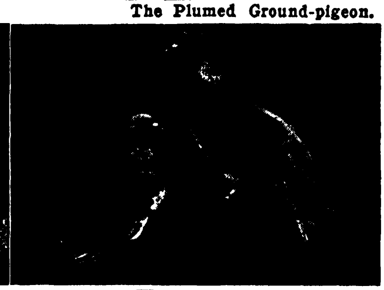

The Nicobar Pigeon.


Blue-rock Pigeons.


The Plumed Ground-pigeon.


Turtledoves.


The Stock-dove.


Wood-pigeons.

against that we have to set the unquestionable fact that it plays havoc in the fields. It eats great quantities of grain; it snaps up the growing green of root crops; it pillages the fruit in our gardens and orchards.

The fruit-pigeons proper are noted for their huge mouths, but one would like to add a personal note to the literature of the wood-pigeon by showing that this bird, too, has ability to eat. One autumn afternoon an observer saw a wood-pigeon gobble down eleven crabapples in succession, each large enough to choke a man to death. There is a suggestion of the snake in this prodigious swallowing capacity of the ring-dove.

Great Britain suffers, not only from the appetites of those wood-pigeons which remain all the year, but also from huge flocks from the Continent which fly across the North Sea every autumn and do immense damage to the crops. The wood-pigeon's note is very melodious, if monotonous, and the bird, so shy in the wilds, is capable of great affection, not only to its mate and its young, but to a human friend.

THE TIMID AND LONG-TAILED DWELLERS IN THE DENSE FOREST LANDS

So far we have considered pigeons in which the wings are longer than the tail, but, passing on, we meet a great assembly of birds, South Asian and Pacific Islanders, which have the tail longer than the wings, and so are called Long-tailed Pigeons, another name of the group being Cuckoo Pigeons. The passenger pigeons, though belonging to the New World, and therefore far removed geographically from the remainder, had unique long tails. These were fatally fearless creatures of the wilds, but the long-tailed pigeons of the Old World are timid, nervous dwellers in thick forest land.

We reach the extremity of either fearlessness or stupidity in another great section called the Mourning Doves from their melancholy note. From their habit of nesting on the ground these doves are

termed Ground-pigeons. America has several species of them in her temperate areas, where the birds, wiser than the poor passenger pigeons, never assemble in great flocks even at migration time, but group themselves in family parties, so that if disaster befalls one section, others continue unharmed.

THE LITTLE TURTLEDOVE THAT APPEARS IN SOLOMON'S SONG

Though our mourning dove is often called the Turtledove, the name properly belongs to a bird of the Old World. The Turtledoves are included among the ground-pigeons. They are to be distinguished by the black or dark collar of feathers traversing the back of the neck. They fly with the same agility among tangled boughs and dense foliage as bats among thronging obstacles. Ranging across Europe and on into Asia, the turtledoves are favorites everywhere. There is no sweeter verbal music in all the Song of Solomon than that in which he has this bird in mind:

> For lo, the winter is past, the rain is over and gone; the flowers appear on the earth; the time of the singing of birds is come, and the voice of the turtle is heard in our land.

The charm of the bird's name is spoiled for us by its misapplication to a sea reptile. The turtle which comes to table was originally called the sea tortoise, but this word has become corrupted into turtle, so that many a child, when it first learns its Bible, imagines that in Solomon's day the turtle of the soup sang songs to cheer the heart of the Eastern king.

Which strain gives us the little turtledoves sometimes kept in wicker cages about the house? Nobody knows. They are cited as the very pattern of fidelity and affection, but the fact is that these little turtledoves quarrel and peck and pluck each other's feathers with a hearty animosity.

THE FEW PIGEONS OF NORTH AMERICA

Strange to say, temperate North America has few of the many species of pigeons and doves. Of course there are millions of tame pigeons, and we have already spoken of the passenger pigeon and the mourning dove which once were common. There is the Band-tailed Pigeon of the Pacific coast, which has a black bar across its bluish tail. Eight or ten other pigeons and doves that belong to the warmer regions of the South are sometimes found in the southern part of the United States. Among them are the Inca Dove of Mexico and Texas, the Ground Dove, a small bird which lives chiefly upon the ground, and the White-winged Dove, another southern species. The White-crowned Pigeon of Mexico and the West Indies is also to be found in great numbers in Florida on the rocks of the Florida Keys. Here it breeds and feeds chiefly on the beech-plum and the berries of one of the palms. Because of its choice of breeding-places it is known as the Rock Pigeon. In the Bahama Islands it forms an important article of food. The nest is built at the end of a cactus shoot or on the upper branches of a mangrove. It is composed of small twigs and lined with grass and fibrous roots.

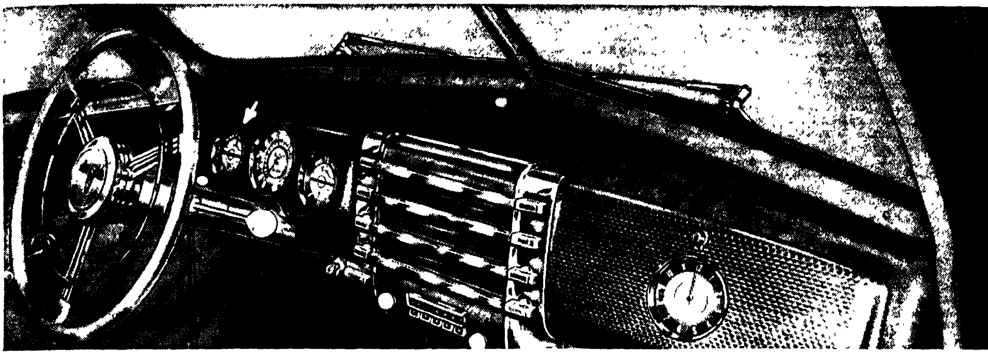
A bird very wonderful in one way fitly ends our procession. It is that strange creature the Tooth-billed Pigeon. The bill is a great, strong, heavy contrivance, massively hooked as to the upper mandible. If we study this beak, we see that it is suggestive of the comic beak of the extinct dodo. The tooth-billed pigeon is, in fact, the nearest surviving relative of the dodo.

THE CHANGE OF HABITS THAT HAS SAVED THE TOOTH-BILL FOR US

But the living tooth-bill is wiser than the dead dodo. Restricted to the Samoan Islands, it was accustomed in earlier days to feed on the ground and to roost at night on low stumps, where it could easily be reached by the animals introduced by man. But a great change has come over the habits of the bird. It no longer seeks a table at ground level, but obtains its food in the trees. It no longer perches for its slumber on modest heights, but roosts each night as high as shelter can be obtained in tall trees. The change has saved its life: the threatened birds abound to-day, and the species is saved.

That is as instructive as the change in the habits of the kea parrot, but much more pleasing. The tooth-billed's kinsman, the dodo, could not have done anything so effective, for he parted with his birthright—the wings which make pigeons fearless of all but a gun, which have given them command of nearly all the habitable world, and rendered them willing helpers of man in bridging the gulf and spanning the void in flight.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 4363.



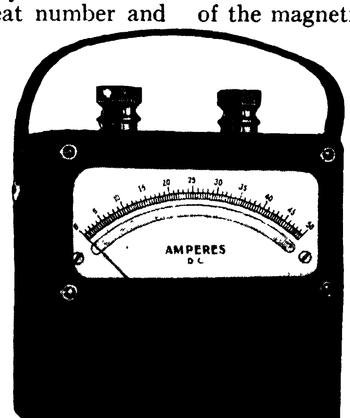
Courtesy, General Motors Corporation
The ammeter (arrow) in an automobile tells the driver whether current is flowing into or out of the car battery.

HOW ELECTRICITY IS MEASURED

YOU have now discovered several interesting things about electricity, including some of the important laws that tell us how electric currents behave. (See starred titles under Electricity, in the General index.) But we have not yet described how one is able to measure electricity.

You know what electrons are—tiny charged particles that revolve about the center of atoms. There are also free electrons, not attached to any atoms, that drift through substances. Electricity is the word that covers all phenomena in which electrons take part.

These tiny electrons are very versatile and therefore they produce a great number and variety of different effects. A stream of them, falling on a piece of metal, can knock X-rays out of their target. When electrons rush through a gas (as in a neon sign) they can cause light to be emitted from the gas molecules with which the electrons collide. Another result of electron action is the magnetic field which one always finds around a wire carrying electric current. Also, heat is created in a wire when electrons rush through it. If electrons flow through certain liquids (like impure water), the chemical compounds in the liquid may be separated by the current.



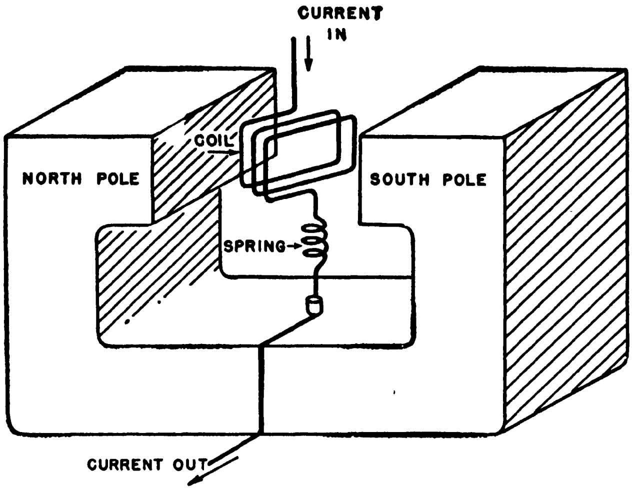
Courtesy, Weston Electrical Instrument Corporation
Ammeter for measuring direct current.

Electricity can be measured by any of these, and by similar, effects. In practice, when talking about measuring electricity, we usually mean measuring one of two different things. We want to find how much electric current flows in a wire, or how many electric charges there are on a charged body.

To measure how large an electric current flows in a wire we could possibly, in a roundabout way, measure the actual number of electrons streaming through the wire every second. But at best this would be very tedious. It is much more convenient to make use of the magnetic, the heating or the chemical effect we mentioned above. In most current-meters the magnetic effect is the one that is chosen.

A *galvanometer* is really a very clever but simple instrument. The electrons of the current we want to measure are allowed to flow through a little coil of wire; and so a magnetic field around the coil is set up. That field will grow stronger if the current in the coil is made bigger.

The little coil is suspended (by means of springs) in the space between the pole pieces of a permanent magnet (see sketch). In



How a galvanometer works. The coil is twisted more and more as the current flowing in it is increased. It is explained more fully in the text.

this position the magnetic field of the permanent magnet and the magnetic field around the current in the wires acts upon one another, and the coil is twisted. The amount of twist depends on the strength of the coil's own field; that is, it depends on the amount of current.

The coil always wants to rotate so that it lines up parallel with the pole pieces. But the springs are set so that the coil can reach this position only for very strong currents. Therefore, by observing how much the coil twists when the current is turned on, we can calculate how large the current is.

Of course, it would be much simpler to attach some sort of pointer to the coil, so that one could read the current value directly on a scale. But galvanometers are such sensitive and fragile instruments that we do not dare to put a heavy pointer on the coil. However, often we are quite willing to sacrifice some sensitivity in order to have a more rugged instrument. This sturdier meter can have a pointer and scale from which currents are read directly; it is called an *ammeter*.

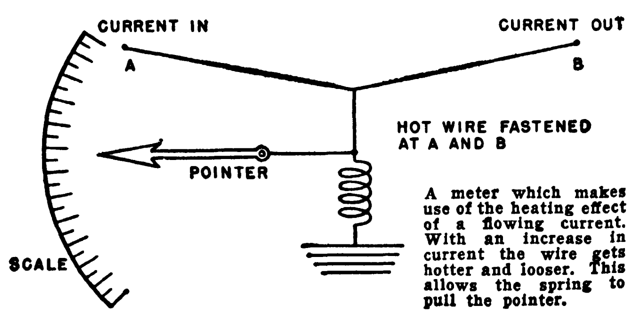
This instrument will not give any large deflection unless billions of electrons flow through it every second. It is unlike the more sensitive galvanometer, which can be built to show currents as little as a few thousand electrons per second. How small this quantity is can be seen by the fact that when you turn on an ordinary flashlight, the current in the filament of the bulb is probably many billions of billions of electrons every second! However, the ammeter is the more practical of the two instruments in most cases, since it allows you to read the current in amperes directly from a scale.

Because in practice currents are apt to be quite large, the whole current is not allowed to pass through the instrument. If it were, it might cause damage in the sensitive and delicate coils. The trick used to measure large currents is quite simple.

By means of a "shunting wire" or "shunt", a large and known proportion of the strong current is allowed to pass right by the meter, without going through it. Only a small fraction of the total current goes into the instrument. This method would correspond to calculating the flow of water in a large river by diverting a definite percentage of it through a small side channel which can carry only, say, a thousandth of the total stream; and then measuring the water in the tiny side channel instead of the big river.

Most ammeters have several different shunts, each allowing a different fraction of the total current to flow through it. If the total current which we wish to measure is quite small, we can use a shunt that allows a larger fraction of the current to flow into the coil. In this manner we get a larger deflection, and therefore also a more accurate reading.

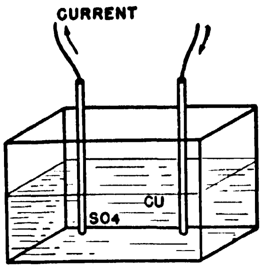
Some ammeters make use of the heating instead of the magnetic effect of currents. This is particularly so if the current used is not fairly constant, but changes in direction of flow many times each second (alternating current). In such an ammeter, the motion



A meter which makes use of the heating effect of a flowing current. With an increase in current the wire gets hotter and looser. This allows the spring to pull the pointer.

of the pointer is controlled by a wire which is taut when no current flows, but grows hotter and consequently slacker (because of expansion) when current does pass through.

In the picture you see that one end of the



Measuring an unknown current by determining the amount of copper it will deposit on an electrode in a given period of time.

pointer is fastened to a spring. If the wire heats and expands, the spring can then contract, and pulls one end of the pointer down, the other up.

The trouble with such meters is that they have very strange scales. The heat developed in a wire goes up with the *square* of the increasing current. Twice the amount of current produces four times the heat; three times the current produces nine times the heat, and so on. That means the wire, once hot, will slacken more and more easily as the current going through it increases. Therefore the spacings on the scale are spread out at the high-current end, and are crowded and inaccurate at the other end.

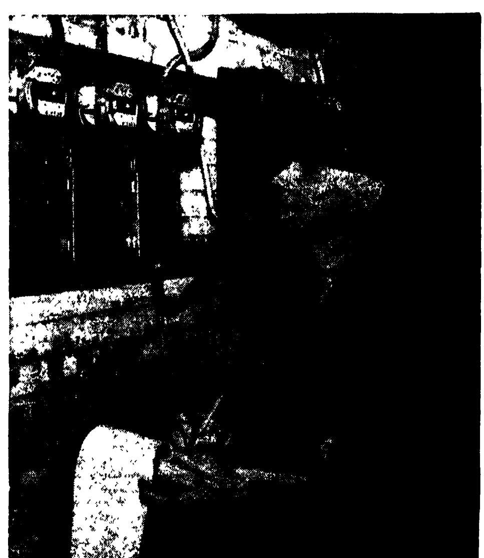
Chemical action is very rarely used for measuring the current strength. It is the most accurate way, but it is a little cumbersome. The current which is to be measured is passed between two electrodes—metal rods or plates immersed in a liquid. Only those special liquids that conduct electricity are useful here; they are called electrolytes. Electricity flows through electrolytes because their molecules break up into separate, charged particles, called ions, which are attracted to one or the other electrode. There the ions give up their charge and sometimes stay to form a fine film on that electrode. For instance, if the electrolyte contains molecules of copper sulfate,—$CuSO_4$—they will break up into negative ions of SO_4 and positively charged ions of copper, Cu. The ions of SO_4 will drift to the positive electrode, and those of copper will settle on the negative electrode. The stronger the current and the longer it flows the thicker will grow that layer of copper. Therefore, to compare the strength of two different currents, one could simply weigh the amount of copper deposited by each during the same period of time.

So far we have talked about ways of measuring the strength of a current in a wire or in a liquid. The galvanometer, or the more rugged ammeter, is put right into the path of the current to measure its magnitude. (Of course, these two instruments must have very low resistance, otherwise they will impede the current they are trying to measure.) Now we want to find out how to measure the voltage, or the potential drop, across a resistor that has a certain resistance and carries a certain current. If you remember Ohm's Law, you know that there is a very simple relation between the resistance R, its current I, and the potential drop V. This relation is of the greatest importance in all work on electricity.

Voltage (V)=Current (I) times Resistance (R). If therefore we know the resistance and use an ammeter to find the current in the resistor, we can calculate the voltage V quite simply. But even if the resistance is unknown, the voltage can be determined; this is done with a *voltmeter*.

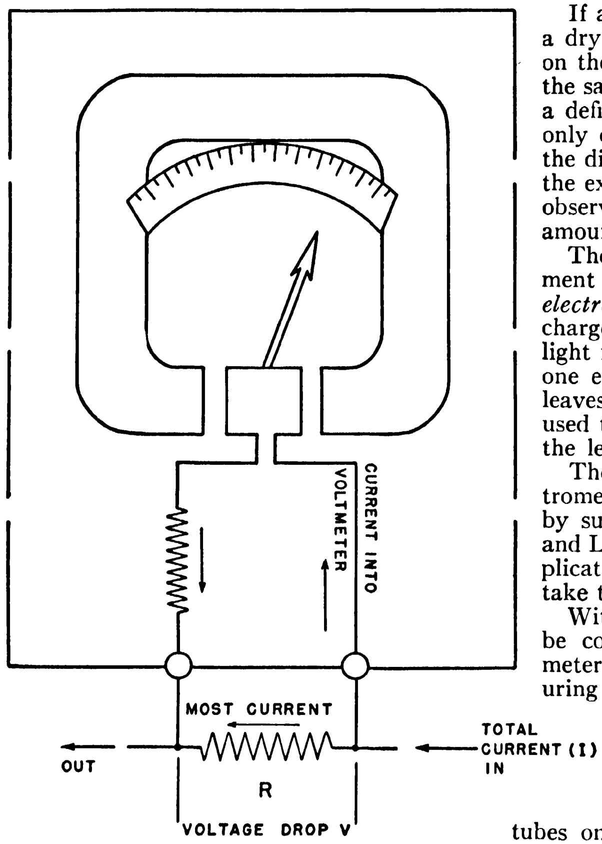
ONLY A VERY TINY CURRENT IS USED BY THIS METER IN MEASURING VOLTAGE

A voltmeter uses the same coil system as the galvanometer and ammeter. It never has a "shunt," and it always has a very high resistance so that only a little current can flow through it. If now our voltmeter is put



Courtesy, Consolidated Edison System

Reading the watt-hour meters. These instruments tell how much electricity was used over a certain period.



The principle of a voltmeter is not much different from that of an ammeter. We tell about it in the text.

across a resistance whose potential drop V we wish to find, a very small part of the total current will go into its coil instead of into R (see sketch). This current is so small that the resistor will not miss it at all, and its voltage drop will not change noticeably. But although the voltmeter takes away only a tiny fraction of the total current, this small voltmeter-current will be an indication of the voltage drop across the resistance R. A large voltage across an unchanging R can be due only to a large current through R (Ohm's Law!). So the current going into the voltmeter is larger, too, and the pointer makes a wider swing on the scale. In this way the meter can be made to "read" voltage directly.

All the instruments we have mentioned so far are useful for measuring electric current, that is, the flow of electric charges in a body. But how about the number of electric charges on a charged body?

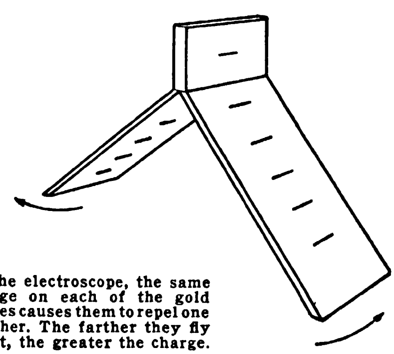
If a glass rod is rubbed vigorously with a dry cloth, positive charges will pile up on the rod. Another glass rod, treated in the same way, will repel the first rod with a definite force. This force depends, not only on the shape of the two bodies and the distance between them, but also upon the exact amounts of charge on each. By observing this force we can calculate the amount of charge on a body.

The instruments for such a measurement of charge are call *electroscopes* and *electrometers.* In the electroscope the charge we wish to measure is put upon two light metal leaves which are connected at one end. The greater the charge on the leaves, the farther apart they fly. This is used to measure the amount of charge on the leaves.

There are several different types of electrometers, among them types developed by such famous men of science as Volta and Lord Kelvin. They are all rather complicated instruments, and we shall not take the time to explain them here.

With some changes, an electrometer can be converted into an electrostatic voltmeter, an instrument very useful in measuring alternating currents.

Lastly, we should mention the amazing family of vacuum-tube instruments to which some of the most sensitive and versatile detectors belong. (There is a story on electron tubes on page 5033.) They often contain electronic circuits which amplify the currents

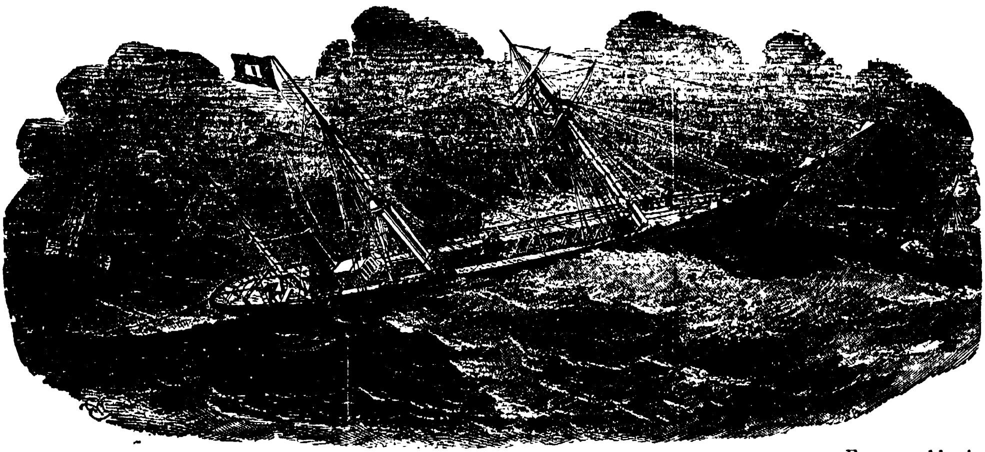


In the electroscope, the same charge on each of the gold leaves causes them to repel one another. The farther they fly apart, the greater the charge.

or voltages we wish to measure, thereby increasing measuring accuracy greatly. Also, they can measure alternating currents and voltages much more easily, even those making thousands of fluctuations every second.

By GERALD HOLTON.

THE NEXT STORY OF SCIENCE IS ON PAGE 4319.



From an old print

Paying out (laying) one of the early cables, in a rough sea.

THE WIRE THAT RUNS UNDER THE SEA

ALL of the inhabited continents of the world, and many of the islands, are connected by a network of cables. These are carefully protected bunches of wires that lie on the ocean floor and carry telegraph messages from one country to another. There are to-day more than 360,000 miles of submarine cable stretching along the bottom of the sea, up hill and down dale, sometimes as much as four miles below the surface of the water. You know that the ocean floor is not flat but has hills and valleys and plains.

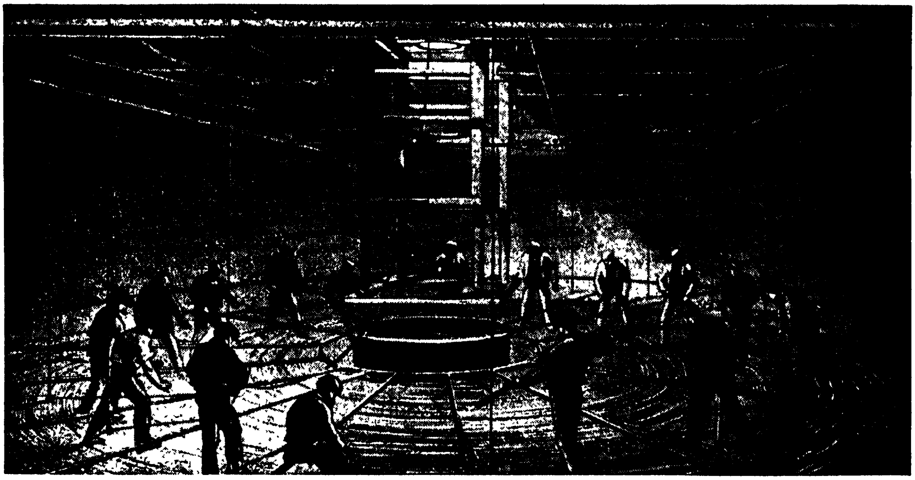
In one day about forty thousand messages (or some twenty-four hundred letters a minute) can be sent through a modern cable. Though many messages are now sent by radio, the cables are still busy, for they can be used at all times, while the conditions of the atmosphere sometimes prevent the sending of wireless messages. Then, too, a wireless message may be picked up by others besides the one to whom it is sent. A cable message is known only in the sending and receiving offices. This secrecy is sometimes very important in business and in the affairs of government.

It was not until after the American Civil War that the first permanently successful transoceanic cable was achieved. This was the Atlantic cable which connected the British Isles with North America. It took ten years of effort before the cable was completed and in good working order, and, like most great engineering projects, it was the result of the invention, labor and money of many different men, and the heroic persistence of a few men.

Until the discovery and invention of the uses of electricity, even the most important messages could travel across the sea only as fast as a ship could carry them. In the days of sailing vessels, this meant weeks and even months. The use of steam and electricity stimulated men to make many new inventions, and a number of brilliant men of the early nineteenth century tried to solve the problem of rapid communication across the ocean.

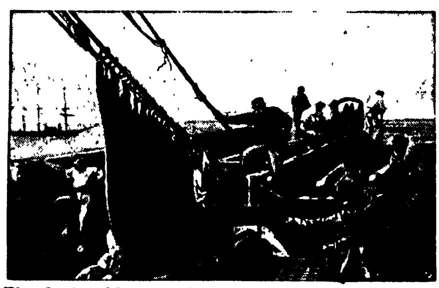
Among those who made experiments with underwater cables was Sir William O'Shaughnessy Brooke, who, in 1838, succeeded in sending messages over a wire that passed through a river in India. Samuel F. B. Morse, who gave America her telegraph, and whose system of signals is everywhere used, sent messages through a copper wire laid in the water of New York harbor. Next, another American, Ezra Cornell, the founder of Cornell University, got a cable to work through twelve miles of water. That was in 1845. The cable worked well for some months, but was then broken by ice. In the following year an Englishman named Charles West tried to lay a line from England to France. Poverty prevented him from

LAYING A CABLE UNDER THE SEA



No ship but the Great Eastern could have carried the 2,300 miles of covered wire required for the Atlantic cable. It was stored in three enormous tanks, which were filled with water to keep the cable from getting too hot or too cold. Here we see the cable passing out of one of the tanks as it was being laid.

The first cable laid by the Great Eastern broke, and was grappled for five miles under the sea. When found, a buoy was let down to mark the spot.



The lost cable was found by dragging over the bottom with iron hooks. Here we see men preparing to lower the grappling-iron.

After many failures the lost cable was found. There was much anxiety as the end was hauled up from the bottom of the sea, but just as it came into sight it slipped away, and all the work had to be done over again. Here we see the scene when the cable was brought on board.

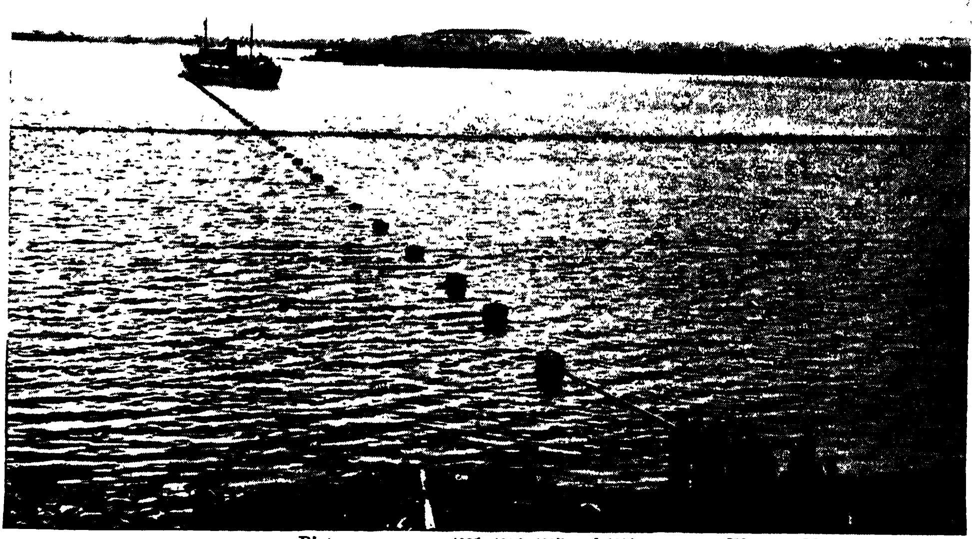
carrying out his scheme, but he got as far as Portsmouth harbor, where, holding the end of his cable in a boat, he sent messages to the shore.

In 1849 a cable was laid for two miles in the English Channel. One end was held on board a ship two miles out from shore. The other end was brought to land at Folkestone and joined to a telegraph wire which stretched to London. Messages were sent back and forth between London and the ship out in the English Channel.

By this time many minds in England and America had become fixed on the idea of an Atlantic cable. In America, Cyrus West Field, who had made a fortune as a paper-manufacturer, was doing all he could to promote schemes for a cable from America to England, and had formed a company for the purpose. In Great Britain, Jacob and John Watkins Brett, two brothers, succeeded in getting the Government's permission to lay a cable between England and France. This they accomplished, after much annoying delay, laying the cable at their own expense. Disappointment soon followed.

The ship with the cable started in August, 1850, and the heavily protected wire was soon landed at Calais, across the straits of Dover. Messages were sent over it by Queen Victoria and Emperor Napoleon III. But the cable suddenly snapped: an ignorant fisherman had dragged it up with his nets and broken it, believing that it was a strange kind of seaweed! A new one had to be laid, and this was followed by others linking various places.

People had by this time ceased to mistake cables for seaweed, or to believe that to make signals they had to pull at the cables as if they were bell-wires. So now the matter of an Atlantic cable became a serious undertaking. The Bretts met Cyrus Field, and they formed a company and engaged a young engineer, Charles Tilston Bright, to carry out the work of joining Britain to America by telegraph under the ocean. Of course, many wise and learned men said that it could not be done. One of the most confident of the opponents was Sir George Airy, the famous astronomer and mathematician. It was impossible, he said, to sink a cable to the bottom of the deep sea, and, if it were possible, such a cable would not convey signals. This learned opposition did not, however, discourage Field and the Bretts.

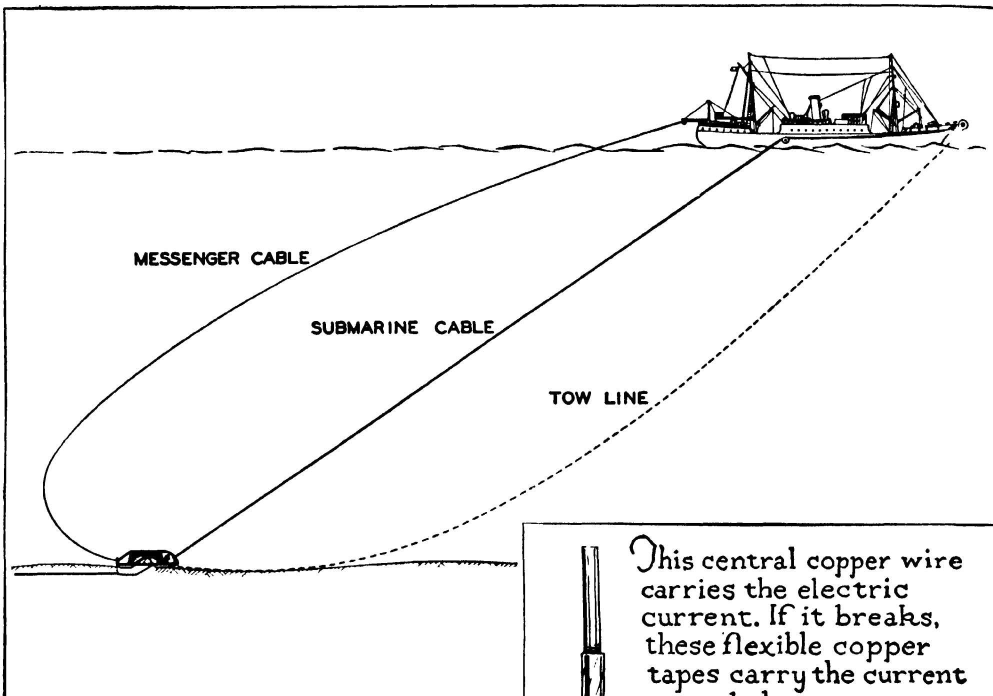


Pictures on pages 4295, 4296, 4297 and 4300, courtesy, Western Union Telegraph Co.

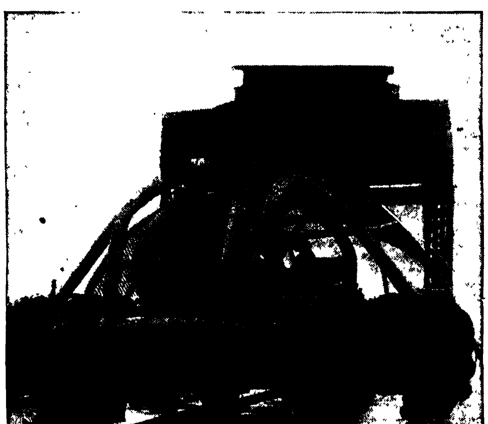
A cable ship is landing the shore end of a transatlantic cable. The cable is floated from ship to shore on barrels, which you can see bobbing on the surface of the water. When the cable is fastened in place at the shore end, the barrels are cut away and the "line" drops into proper position on the ocean floor.

On August 5, 1857, near Valentia, Ireland, the process of unwinding the cable, nearly 2,500 miles of it, was begun by two ships, the American frigate Niagara and the Brit-

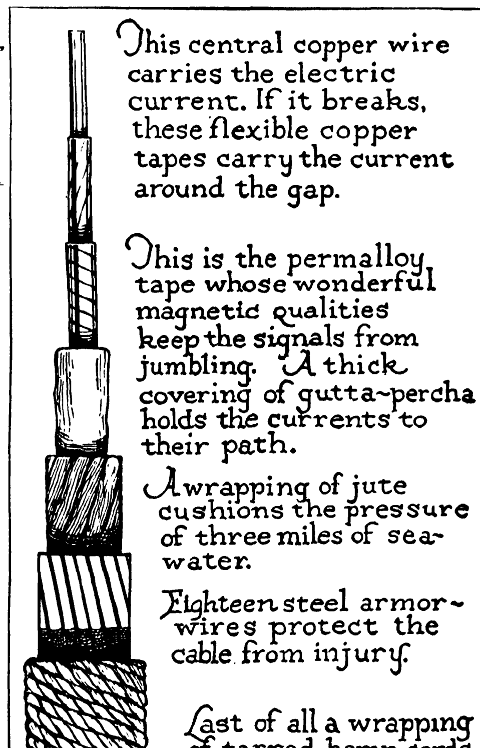
MODERN METHODS OF CABLE LAYING



Towed by a ship, this ocean plow digs a channel in which the cable is buried for greater protection in areas where fishing nets are dragged along the ocean bottom. The messenger cable sends electrical signals to a recorder on the ship showing the depth of the trench and the inclination of the plow.



The cable plow developed by Western Union engineers to bury cables in the floor of the ocean. The plow is twenty feet long and weighs ten tons.



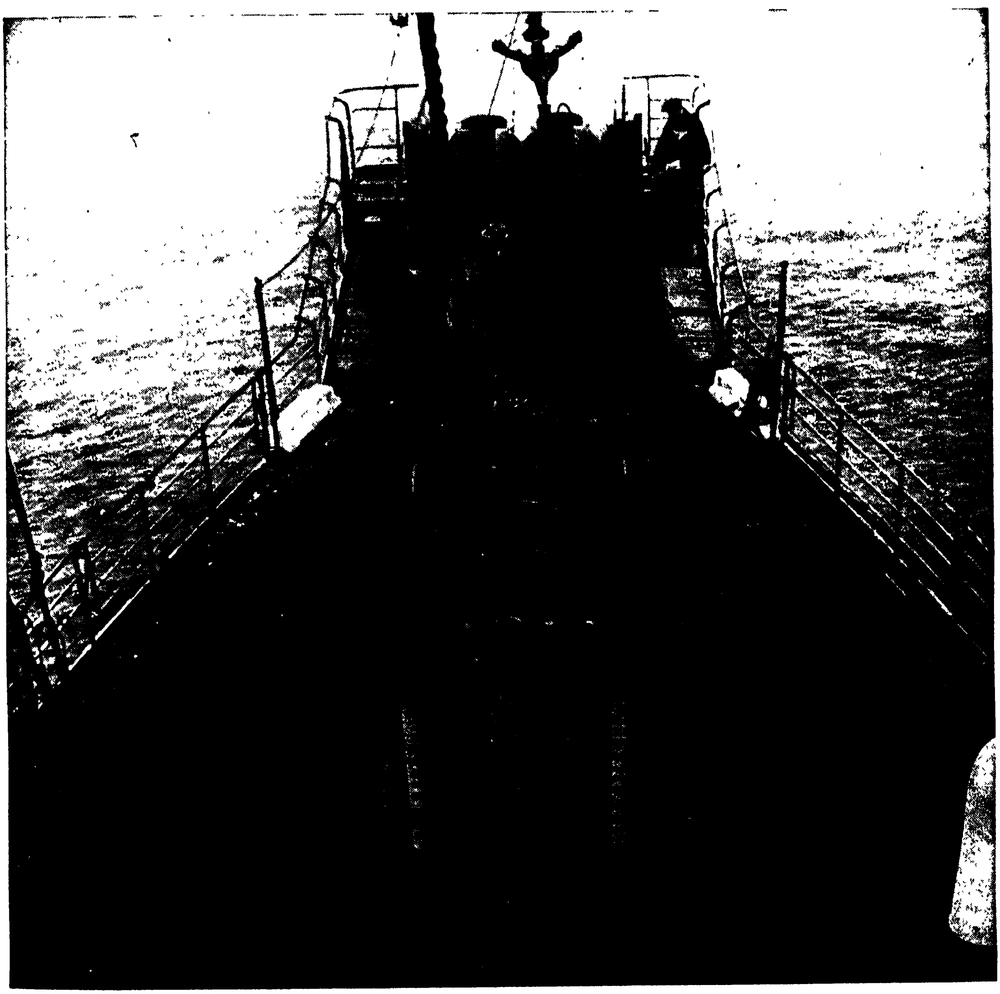
This diagram shows how Western Union's fast cable is built up layer by layer. Such a cable is used to send more than 2,000 letters per minute.

ish ship-of-war Agamemnon. About 300 miles off the coat of Ireland the cable snapped under the strain of a sudden dip in the seabed, and the ships had to return, leaving the broken cable at the bottom of the sea. The whole thing had to be started over again, at enormous expense.

The second attempt, in June, 1858, was also a failure. This time the two ships, each carrying half of the cable, met in the middle of the Atlantic, joined the two cables together, and steered in opposite directions, one toward Ireland and the other toward Newfoundland. The cable broke three times, and the project was, for the moment, abandoned. People on both sides of the Atlantic again lost faith in the project, and said that an ocean cable could never be laid.

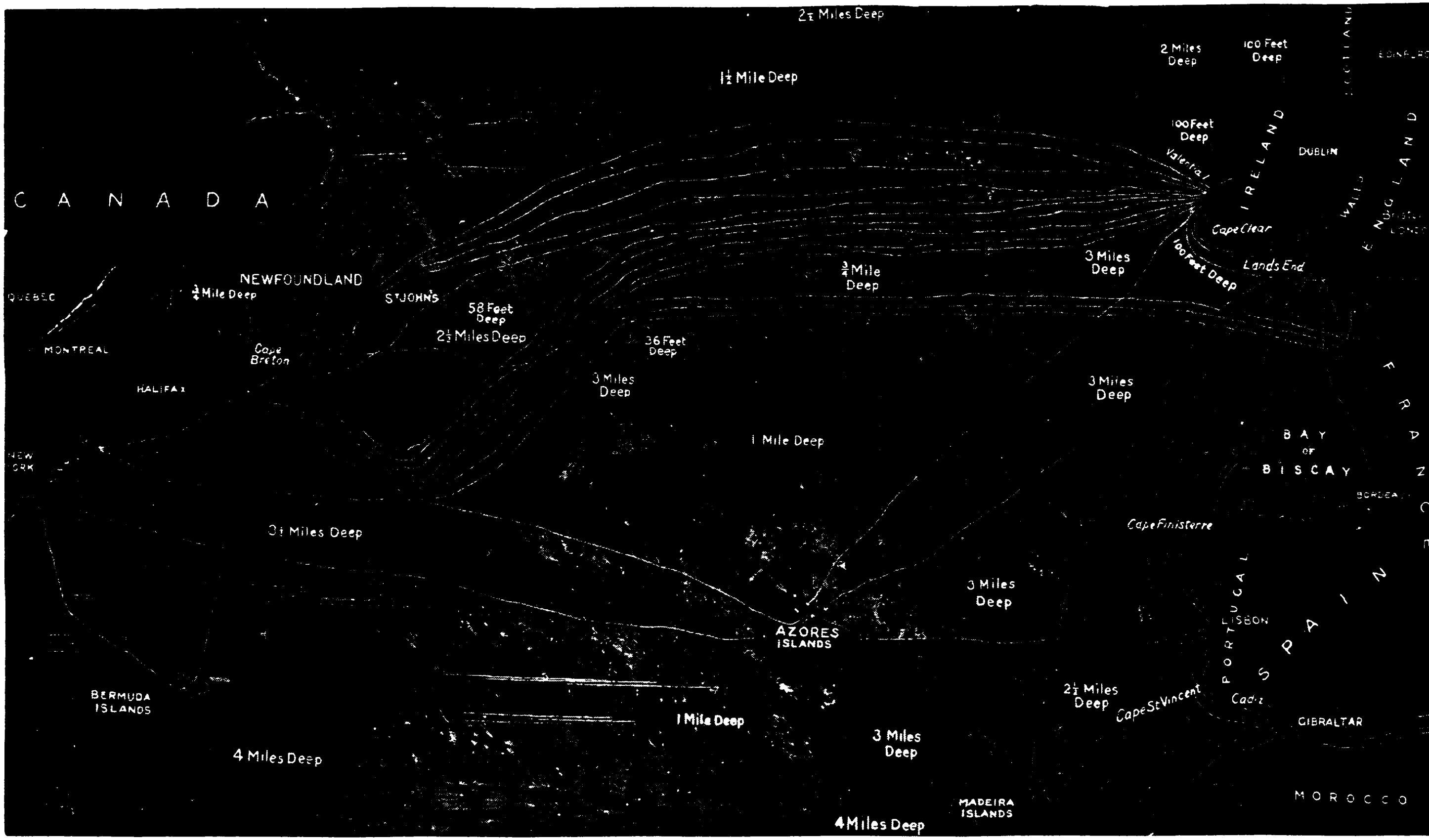
A month later another effort was made, however, and this time the two ships started from mid-ocean and succeeded in paying out the cable without accident, so that one end was drawn up on dry land at Valentia, and the other at White Strand Bay in Newfoundland. A great event in the world's progress had taken place.

The British and American backers of the undertaking sent each other messages of joy



Here we see the bow of the Western Union Cable Ship Lord Kelvin. Each of the number scales near the centre is the indicating part of a dynamometer, an apparatus which measures the amount of pull on the cable, wire or chain being raised or lowered. Too great a strain would snap the cable. At the top of the picture, above the drums over which the cable runs, the Y-like mechanism is the Lucas cutting grapnel which can catch a cable on the ocean floor, cut it in two, and bring either end to the ship for testing and repairing.

WHAT IT IS LIKE AT THE BOTTOM OF THE ATLANTIC OCEAN



If the water in the Atlantic could be drained, the ocean bed would look like a great stretch of country with deep valleys and high mountains. These mountains would be the islands that now only peep above the waters. Stretching across the new country we should see the many cables that enable the Old World and the New to talk together. In the shallower parts of the oceans, the cables usually have a thicker diameter for added strength, so that they may be better able to withstand waves, anchors, fishing operations, marine growths, winds, changes in temperature and other near-surface conditions.

and congratulation, and Queen Victoria sent a message of ninety words to President Buchanan. The current was too weak for the long journey, however, and the signals came over slowly. The cable lasted long enough to prove that messages could be sent by electricity more than two thousand miles under water. A few hundred messages were sent; then, in less than a month, the cable ceased to work.

THE TRANSATLANTIC CABLE IS AT LAST SUCCESSFUL

During the next two years a new company was formed, and in 1865 the Great Eastern, the largest ship built up to that time, was sent out to lay another and better cable. This cable broke too, but one more effort was made with a lighter but stronger cable, and this time the Great Eastern was successful. Ireland and Newfoundland were permanently connected by cable on July 27, 1866. In the following year the cable that the Great Eastern had previously lost was found, a fresh section was joined to it, and there were now two cables across the Atlantic. Today there are many.

Some of the transoceanic cables are more than 3,000 miles long, such as the section of the Canada-Australia cable that stretches from Vancouver to Fanning Island. Some of them have to cross at great depths, such as the cable between San Francisco and Honolulu, where the sea is more than five miles deep in places.

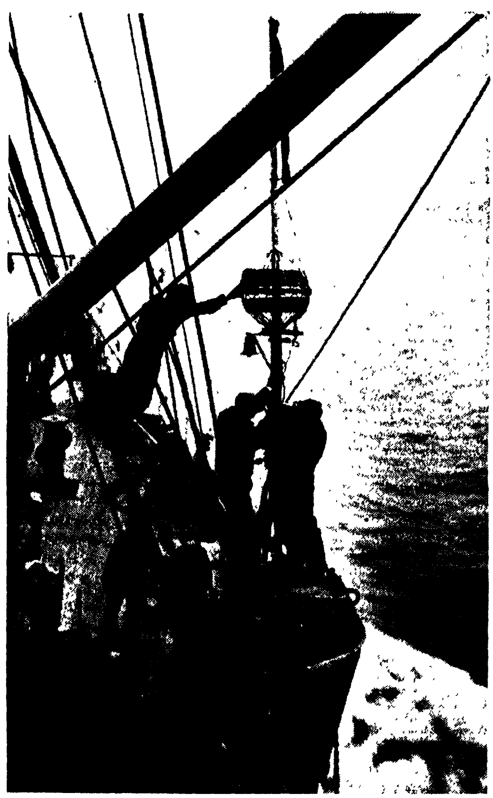
THE MANY MATERIALS IN A HIGH-SPEED CABLE

In modern high-speed cables, about 560 pounds of copper and 450 pounds of gutta percha are used for each mile. These cables consist of a core of copper wire, with flexible copper tape wound around it; over that, a permalloy tape, which has magnetic qualities that permit the sending of a number of messages at one time, without jumbling or mixing them; a thick covering of gutta percha; a wrapping of jute to cushion the pressure of miles of sea water; eighteen steel armor-wires, and finally, a wrapping of tarred hemp cords.

The signals sent through the first cable were, as we have said, faint and sometimes difficult to understand. In 1867 Lord Kelvin invented what was called a siphon recorder to make signals stronger and clearer. It also increased the speed in sending messages over the wires.

When the first messages were sent, the greatest speed was only about six words a minute. Through modern high-speed permalloy-loaded cables, an average of over 2,000 letters or characters per minute can be sent. By the code system one word stands for a number of words, or for a phrase, and this provides economy and secrecy for the user.

As we have mentioned, it is possible to send several messages over a wire at the same time—as many as eight in a single direction. One end of the cable can be connected to eight sending machines, and the other end to eight printing telegraph-receiving machines, each machine engaging the full attention of an operator. Each sending machine, which looks like a typewriter keyboard, is timed so that any signal sent from it will reach one particular receiving printer and not any of the other seven. The eight separate transmission (sending) paths so provided may either be kept busy or left idle, depend-



Ewing Galloway, New York

When a cable breaks, men on the repair ship fix a signal buoy to one half of the break (or fault, as it is called), find the other piece, bring it back to the first one, and splice the two.

The sender punches holes representing letters in the tape. Electric contacts through the holes send the cable.

The automatic printer that translates the code impulses, arriving on the cable, into letters.

Sending pictures by cablephoto from London to New York. The system works by means of an electric eye.

ing upon the number of messages to be sent from moment to moment.

Suppose that four of the eight sending printers at New York are sending four separate messages into four receiving printers in London. Suppose that the first of the four messages contains the word "boy," the second the word "cat," the third the word "pig," and the fourth the word "hen." Very quickly, one after the other, the machine will pick up and transmit the first letter of each of these words, in turn. The machine will first pick up BCPH, the initial letters of boy, cat, pig and hen; then, without pausing, it will pick up the middle letters, and, finally, the last letters of these words. The order in which these words would be sent over the cable would be: BCPHOAIEYTGN. They look all mixed up to us, but they really are not. Each receiving machine is timed to pick up every fourth letter that comes over the cable and the four words are gradually built up, one at a time, on London's four printers, just as they were broken down and sent one at a time in New York.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4358.

Olaf of Orchard Farm

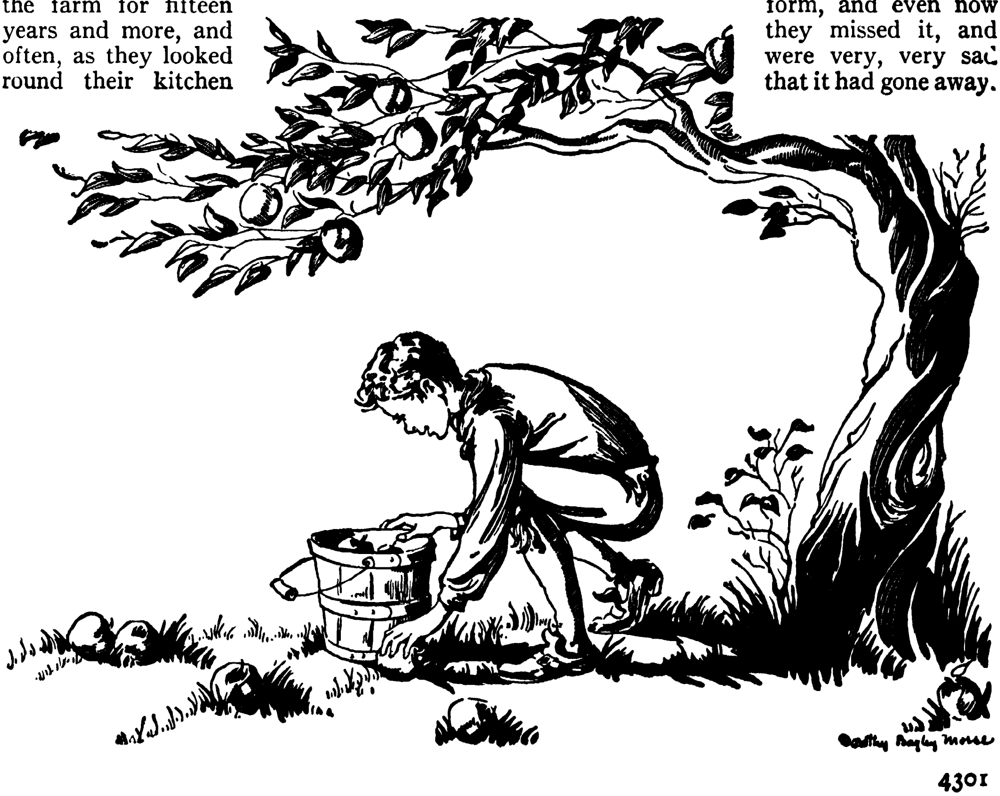
OLAF was a little boy who lived on a farm in the North Country, where the gray rocks show through the green grass. He lived at Orchard Farm, set snug in a nook between two hills.

The farm took its name from the orchard behind the house, where apples and damsons ripened red and green and purple, among the bracken and the heather. Olaf used to play in the orchard when he was a very little boy, and later, when he was a big boy.

He used to play under the apple trees, thinking of the tales his father told him, and particularly of the brownie that had once lived at Orchard Farm, and had gone away because his father had given it a little pair of green breeches and a brown coat for saving his wife so much of the housework.

For the farmer and his wife had been on the farm for fifteen years and more, and often, as they looked round their kitchen and saw the brass kettle shining so brightly over the mantelpiece, and the warming pans glittering on the walls, and the hams hanging up among the beams, and the black kettle that was used every day singing on the hearth, and the floor that was scrubbed I don't know how many times a week, and the wooden table that was scrubbed even cleaner, they would remember ever so long before—before Olaf was born—how there had been little need to work on these things, because while the farmer's wife was sleeping in bed, a little live thing would come night after night, and clean the floor and scrub the table, and put a shine on the kettle, and the warming pans.

They remembered those times, and they sighed to think that the little live thing had left them. They had learned to love the little thing, though they had never seen its tiny form, and even now they missed it, and were very, very sad that it had gone away.



Olaf used to spend his days picking up the windfall apples in the orchard, or watching the sheep grazing on the short grass. Sometimes he would help his mother with the churning, or watch the saucepan to see that the porridge did not boil over. But whatever he did during the day he was always ready to meet his father, and the big farmer used to come into the kitchen carrying Olaf on his shoulder, and saying, "A story, my son?"

And Olaf would climb down and run and fetch his father's slippers. And his father would sit down heavily in the big chair, and take Olaf up, and talk of the little live thing that used to wash the dishes and keep the whole farm as clean as a new pin.

"And tell me why he went away," Olaf said one evening.

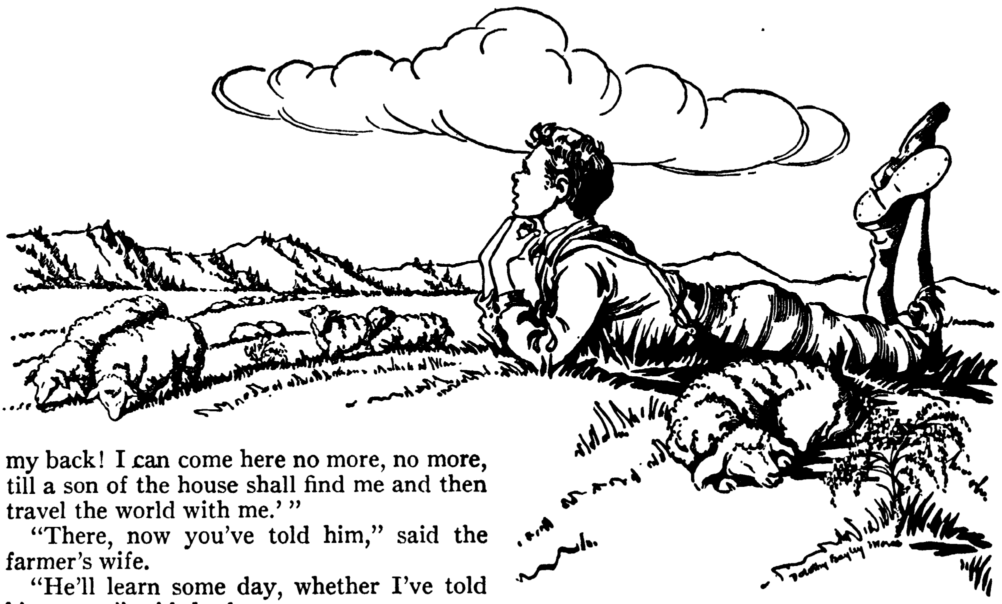
"Well, my son," the farmer said, "there's great pride in brownies. They'll work their fingers off for love, as you may say, but you mustn't thank them. Not that you mayn't put them a saucer of good milk, with the cream in, outside the door of a night. Many's the night I've seen your mother take the saucer, and lift the latch and slip out to leave it for our brownie. But that's all gone now. You may give them milk, and they'll take it friendly as it's meant. But if you pay them, they'll take what you give them, and never come again, unless—"

The farmer's wife interrupted.

"Don't tell the child the way to get the brownie back, or he'll think of nothing else, and go traveling over the wide world by night, and maybe never find his way back."

"No, lass, I won't tell him. Well, my son, you must give him nothing, or you will lose him. And I, fool that I was, I was so grateful to the little thing for all he had done for us that I thought to myself, 'I'll not let him work for nothing. That little one must have fairly worn his coat out slaving for us, and as for his trousers, who knows what a state they're in with him running to and fro?' So I brought back a piece of fine green cloth and a piece of brown, and your mother there sat up all night a-cutting and a-stitching, and in the morning the things were done, as neat a little pair of breeches and as handsome a coat as ever she made for you.

"That night, when your mother put the milk out, she laid the clothes beside it in a little parcel, and in the middle of the night we heard the little thing talking to itself. 'A nice pair of breeches,' it says, 'and a coat to



my back! I can come here no more, no more, till a son of the house shall find me and then travel the world with me.' "

"There, now you've told him," said the farmer's wife.

"He'll learn some day, whether I've told him or no," said the farmer.

Olaf thought of the brownie all the time after that night. He asked every one he knew where to find the brownie. He asked the oldest apple tree in the orchard—the one with the twisted trunk, but the tree said nothing. He asked the cows, but they said nothing. He asked the dog, and it barked about other things. Only the sheep helped him. When they had been cropping near low bushes and their wool was full of little rough brambles Olaf thought they seemed to *want* to tell him something. They said nothing, but they looked as if they knew. He tended the sheep throughout the year, and watched the young lambs grow into big sheep, and watched the old sheep lying in warm places in the spring sunshine while the new lambs played about them. He wondered if the lambs had been told where the brownie was hidden, and he half thought he might be lucky enough to overhear the old sheep telling them about it.

The farmer and his wife saw that Olaf was happy to be with the sheep, so they sent him every day to see that the flock did not stray too far away over the moorland. All through the summer days Olaf used to lie among the heather, saying to himself, "Finds me first, and travels the world—finds me first, and travels the world."

At last, one June evening, as he was coming home from the sheepfolds, he heard the music of bagpipes, small and very faint, near him on the moorland.

He heard it again the next night, and the night after that, and every night, until at last, one midsummer evening, he made up his mind to follow it and find out who it was that played the pipes so sweetly.

He left the path and followed the music, walking warily lest he should lose it. It sounded soft and faint, and always from before him, as if it came from the pile of rocks on the moor where there is a cairn, and where a little mountain ash waves in the breezes.

"Maybe it is the old people who live under the cairn," thought Olaf, for there is a tale in the countryside that a race of little people were buried beneath the pile of stones, and

that they come out to dance on summer nights in the moonlight, though no one has ever seen them.

As he came near the little precipice he knew that the music was directly above it. So he started to climb up. Halfway was easy enough, and he won his way up to the mountain ash. He twisted himself over it, and rested there, wondering how to get higher, for he saw six feet of smooth rock up to the top, where there was a thick mass of heather.

There was a crack in the rock about halfway between the ash and the heather, and Olaf clung there, unable to climb farther, and knowing that if he slipped he would fall toppling to the bottom. And all the time the music of the bagpipes, scarcely louder than a concert of bees and crickets, sang close above his head.

"Oho, there—you with the music!" Olaf shouted at last.

The music stopped suddenly. A little brown face with a small white beard looked eagerly through.

"So it's Olaf at last!" it said.

A thin, brown, hairy little arm stretched down through the heather and caught Olaf by the wrist.

"Pull now," said the little thing.

And Olaf pulled, and the muscles jumped out on the hairy little arm, and Olaf found himself scrambling over the top.

He lay sprawling on the edge of a little cleft in the rock, with high walls on the sides and, far away in the midsummer night, the shapes of the hills covered with pine woods that slope to the edge of the sea. In one of the walls of rock there was a little cave, and just in front of it was a wee three-legged stool that had been upset, and a little set of bagpipes on the ground beside it. "I've been waiting for you a long time," said the little brown thing, as he helped Olaf to his feet. "Look!" And he ran into the cave, and came out dragging a broom behind him, and holding a stone so polished that even in the dim light Olaf could see his face in it. "I've worn out two hundred and thirty of these brooms," he said; "and polished that rough stone smooth—all for want of proper work since I had to leave the farm."

"Will you come back to the farm now?" asked Olaf.

"Not yet," said the brownie. "We must

travel the world together; and then—why, then I'll give those warming pans a shine. It's a terribly long time since I was at them. Your father should have known better than to pay a brownie. He should have known that we work for love, and here I have been all these long years polishing a stone, and wearing out brooms on the rock, waiting for the child of the house to grow up and to find me. And you've come," said the brownie, dancing into the cave, to fetch a little wooden cage with a big cockchafer inside. He opened the cage and took the cockchafer on his finger.

"You've found me," said the brownie—"you've found me; and now there's nothing left but the travels. For I'm to do a deal for you, and you for me, before I can work at Orchard Farm. Fly, cockchafer," he cried; "fly fast and straight, and tell my brothers in the pine wood by the sea. Tell them to launch the boat. Tell them we are coming."

He let the cockchafer fly from his hand, and it boomed away in the still air of the summer night. An owl was calling in the valley. And Olaf heard the "krrrrrrrrr" of a nightjar in the pine woods.

And that is how Olaf of Orchard Farm found the brownie, and came to make his travels with him. And if I did not hear your mother coming to blow out the candles and tuck you into bed, you should hear tonight of how they sailed to the Glittering Harbor, where the Sultan's ships lay close together in the golden sunset, and how they won a wonderful horse, and how they found the white flower that can be bought only for love, like the brownie's services.

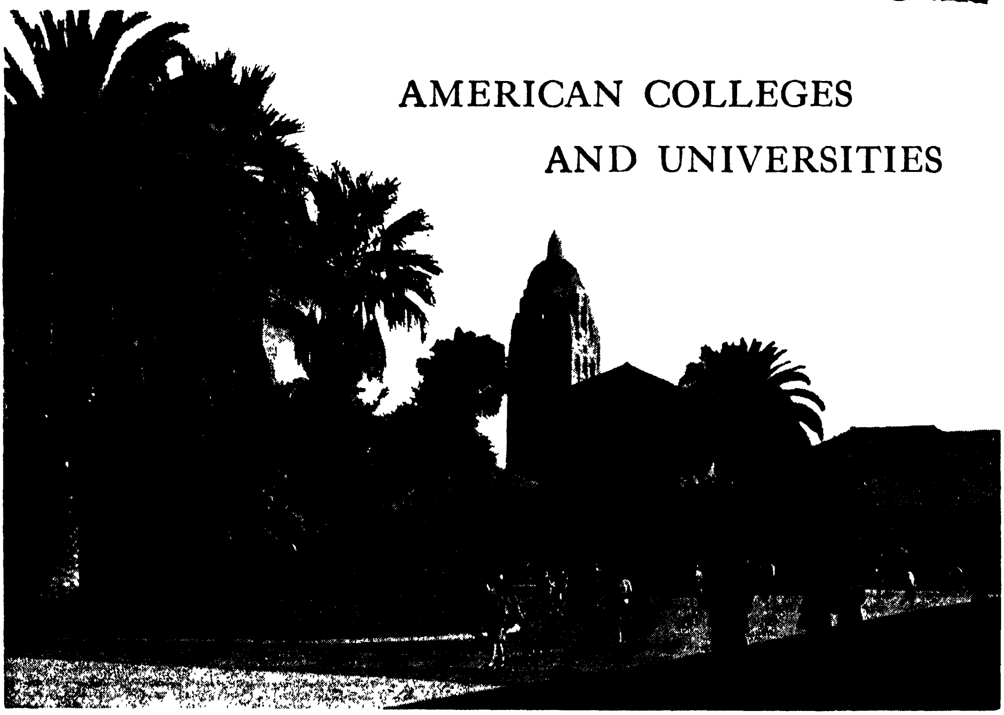
But that is why at Orchard Farm, although Olaf's father and mother are bent and old, and sit in the chimney corners, the kitchen floor is wonderfully scrubbed, and the pans shine brighter than those in any other kitchen of the countryside. And that is why Olaf, though he manages the farm now and has married a king's daughter, goes always with her in the evenings to lay a saucer of milk beside the door.

"We can give him that, at least," says Olaf —"and as much love as we can spare him."

And the brownie scrubs the pans and polishes them till they shine, and washes the dishes, and is very, very happy to know that he will never be paid for it.

THE NEXT STORIES ARE ON PAGE 4481.

AMERICAN COLLEGES AND UNIVERSITIES



Courtesy, Stanford University

A view of Stanford University, Palo Alto, California, showing the tower of the Herbert Hoover War Library.

THE growth of colleges and universities in the United States has practically gone hand in hand with the growth of our country. The first white settlers who came to America were seeking a new home, and some of them brought advanced ideas of education. Through their efforts and the efforts of the Americans who came after them, more than a thousand colleges and universities have been founded and fostered in this country. In modern times the United States leads the world in the number of its schools of higher education. Through individual enterprise, community projects, religious zeal or state programs, colleges and universities of all kinds sprang into being in America and flourished as the country grew. The scholarship standards of all these schools naturally are not uniformly high. Some are on a par with or better than any in the world; in others there is still much room for growth and improvement.

The words university and college are very often used interchangeably in the United States. However, although they both refer to institutions of higher learning, there is a real difference between the two terms. In Roman times a *collegium* was a body of colleagues or people bound together by common interest and engaged in common pursuits. Gradually, however, the word became associated with learning, and colleges were formed within universities by students and teachers interested in a common branch of learning. Consequently, a college was only a part of a university.

Coming from the Latin word *universitas,* the term university originally referred to any community or corporation and eventually came to mean a community or corporation established for the purposes of instruction and advancement in all fields of knowledge. The university's task is no small one; it must cover all or some of the most important branches of learning on the highest level of possible effort; it must include a study of modern problems as well as age-old questions; it must be the home of thinking and of research and most of all, it must train men and women to live in a modern society

and to realize the benefits of the experience and thought of the many generations which came before them. To do all these things a university must be a great center of learning—a collection of numerous schools and colleges.

THE DIFFERENCE BETWEEN A MODERN COLLEGE AND A MODERN UNIVERSITY

The modern university is usually an association of an undergraduate college of arts and science, graduate and professional schools, research institutes, libraries, museums and any other organizations necessary for the pursuit and advancement of learning. An institution of advanced education, the university has the power to confer certain honors or dignities which are called degrees. Different degrees are awarded for study in different fields.

The undergraduate college is the heart of the modern university. It accepts as students boys and girls who have completed four years at an accredited high school or preparatory school. After four years of work in a college, if they have kept a required standard of achievement in the subjects studied, the students receive their first degree —either Bachelor of Arts (A.B.) or Bachelor of Science (B.S.).

There are many colleges that operate independently and are not associated with universities. There have also been established in recent years many junior colleges. They offer two years of college work, after which students may receive the partial degree of Associate of Arts. To obtain a full degree they must transfer to a standard college for two more years of work.

IT IS POSSIBLE TO STUDY FOR A COLLEGE DEGREE AFTER TWO YEARS OF HIGH SCHOOL

Some modern educators believe in establishing two-year colleges, which will confer an A.B. or a B.S. Some educators suggest that these new schools should become directly connected with the public-school system so that most high-school students would be able to go on to obtain a college degree. Although this plan has little chance of being put to immediate general use, the University of Chicago has adopted the system and is now granting degrees after only two years of special study. The study program is a four-year one; but students are accepted after two years of high school. High-school graduates may enter for the last two years only.

The college graduate wishing to pursue learning beyond the four-year program of

Courtesy, Yale University

The Harkness Memorial Tower of Yale University, New Haven, Connecticut. Yale is one of America's oldest and most famous educational institutions.

Courtesy, Vassar College

The three original buildings of Vassar College when it opened in 1865. Vassar is at Poughkeepsie, New York.

study may continue his education in the graduate school of the university. Most universities confer the second degree—either Master of Arts or Master of Science—after one more year of study and after a Master's essay has been written beyond the Bachelor's level.

To earn the degree of Doctor of Philosophy (Ph.D.) or Doctor of Science (D.Sc.), at least two more years of intensive study are required. The student must then pass comprehensive examinations in his chosen field of study; he must do extensive research and present a long essay, commonly called a thesis, or dissertation, which represents an original contribution to knowledge. In working for an advanced degree, the student concentrates in one field; he also takes up subjects relating to his main field. For example, a person working for a doctor's degree in mathematics would probably also study some physics, as this is a subject very closely related to his major interest.

Besides the graduate school, the university has professional schools in which advanced study may be undertaken. Special schools for law, medicine, dentistry, engineering, education, theology, music, agriculture, business administration, architecture and many other fields are at the student's disposal when he has decided on his future vocation. Many of these schools present special degrees.

Not all applicants are allowed to enter colleges and universities. Methods of selection make sure that students meet certain standards of scholarship. These help to determine the various abilities and capacities of aspiring scholars. Formerly each college held its own examinations. This method of selection has almost disappeared in favor of examinations set by the College Entrance Examination Board, an intercollegiate council organized in 1900. However, the overwhelming majority of students are admitted to college by certificate, without examination. A certificate is a recommendation from the student's preparatory school saying that he is in the upper portion of his class scholastically. Usually he must be

Courtesy, Vassar College

Croquet players and a girl in riding costume at Vassar in 1865.

one of the highest 7 per cent. This plan has not proved entirely satisfactory, since the various secondary schools have different standards. Whatever the method of selecting students, high college standards have a good effect on school standards.

Life in a modern American college or university is not made up purely of studies. Today most universities and colleges have a highly organized extra-curricular life. (Extra-curricular means out of the classroom.) There is, for one thing, a nationwide fraternity system in most colleges. organizations at colleges and universities throughout the country. However, there are some colleges, like Princeton, Smith and Vassar, which do not have them.

The first fraternity to be formed was Phi Beta Kappa, founded at the College of William and Mary on December 5, 1776. It was a purely social club and had only five members at its beginning. However, in 1826 the society changed its character and became an honorary organization for general scholarship. It admits each year a certain proportion of students with the highest standings.

View of Harvard College about 1770. Four of the buildings shown are still standing. The picture is from an engraving made by Paul Revere.

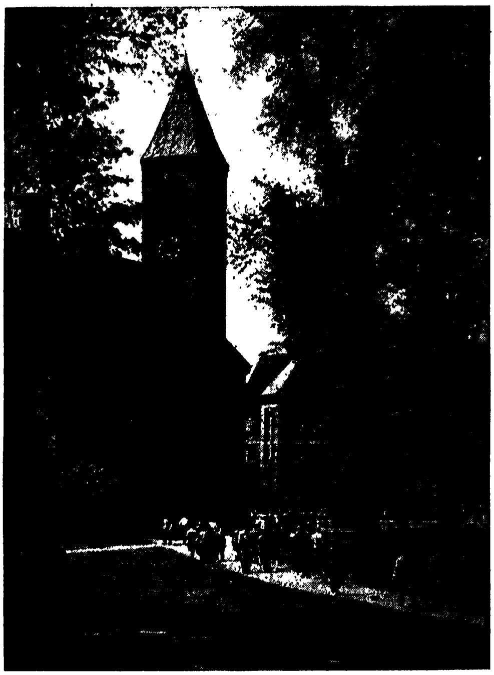
Courtesy, Harvard University
The Harvard University Library has one of the world's largest collections of books. Only the Library of Congress has more.

Based on the Latin word *frater*, which means brother, the term fraternity originally meant an organization in which the members tried to treat each other as brothers. Today the term usually refers to a student society organized for social or other purposes.

Fraternities are peculiar to schools in the United States and Canada and are frequently named for letters of the Greek alphabet. They are often called Greek letter societies. The process of selecting members is called rushing and is usually directed at incoming students. The older members try to select people with relatively the same backgrounds and tastes, and the young men living together with common interests throughout college years often form lasting friendships. Societies for women are called sororities (from the Latin *soror*, sister).

American fraternities and sororities are very highly organized. Each society has central headquarters, and the branches, which are called chapters, are the individual Other national honor societies are Sigma Xi for science, Tau Beta Pi for engineering, Phi Kappa Phi for general ability, Alpha Omega Alpha for medicine and Order of the Coif for law.

Athletics and physical education, too, have a place of importance in the modern university. Most undergraduates must take part in gymnastic classes or active sports during the last two years. In some instances, however, athletics have taken an overly large portion of the college program, so much so that educators have become alarmed. Football, for instance, sometimes appears more



Courtesy, Cornell University

Students crossing the campus on the way to classes at Cornell University, Ithaca, New York.

important than scholarship. More than one educator has tried to abolish sports competitions between schools.

Athletics, social organization and social activities have an importance which can not be overlooked. Besides furthering learning, the modern university is trying to train American youth to use their leisure time to best advantage. In the years ahead the ordinary man will have much more free time than he has today. Training for leisure will more and more become an important part of our educational system.

The roots of American universities go back into English and European education and religious life. The first settlers who came to this country were representatives of European people with (for their time) advanced ideas and ambitions. From the start, there was a strong passion for schools.

The first steps toward provision for higher education in the English colonies were taken in 1636, when the General Court of the Colony of Massachusetts voted an appropriation of £400 toward the establishment of a school or college. The next year it was decided that "Newtowne" would be the seat of the institution, and in 1638 the town was called Cambridge in honor of many of the leading men of the community who had been educated at Cambridge University in England. The actual naming of the college did not come until John Harvard died in 1639 in Charlestown, Massachusetts, and bequeathed half of his fortune to the wilderness establishment. This sum was almost double the amount voted by the Court.

John Harvard had been a Puritan minister and a master of Emmanuel College of Cambridge University. Coming to America from a center of learning, he had immediately become interested in the birth of this new school in a new world. In addition to the money he also left to the college more than 300 books. Then the school was actually organized, and from 1640 to the present day the history of Harvard has been one of almost continuous growth. The first commencement was in 1642, but not until 1650 was the charter granted. According to the charter, the college was dedicated to the advancement of literature, the arts and sciences and to the education of English and Indian young men in knowledge and godliness. A number of Indians did attend the new college, but only one took his degree. Caleb Cheeshahteaumuck was graduated in 1665.

The college charter, in its original form, is still in existence today; and Harvard is still conducted under that first contract. Although it started in a small way, Harvard College grew vigorously. The undergraduate school flourished, and graduate and professional schools were added—schools of law, medicine, dentistry, business administration and others. A university famous throughout the world grew up around the original college.

WILLIAM AND MARY COLLEGE IS FAMOUS AS THE BIRTHPLACE OF PHI BETA KAPPA

The second oldest college in the United States, William and Mary College in Williamsburg, Virginia, experienced many growing pains. In 1619 grants of land were obtained for an institution near Richmond, and a collegiate school was established at Charles City two years later. However, the Indian massacres of 1622 wrought destruction in the little town, and the plan for the school was frustrated. In 1693 the Reverend James Blair, who became the first president of the college, secured a charter from King William and Queen Mary of England. A penny a pound on exports of tobacco and the profits from the office of the Surveyor-General of Virginia went to the institution.

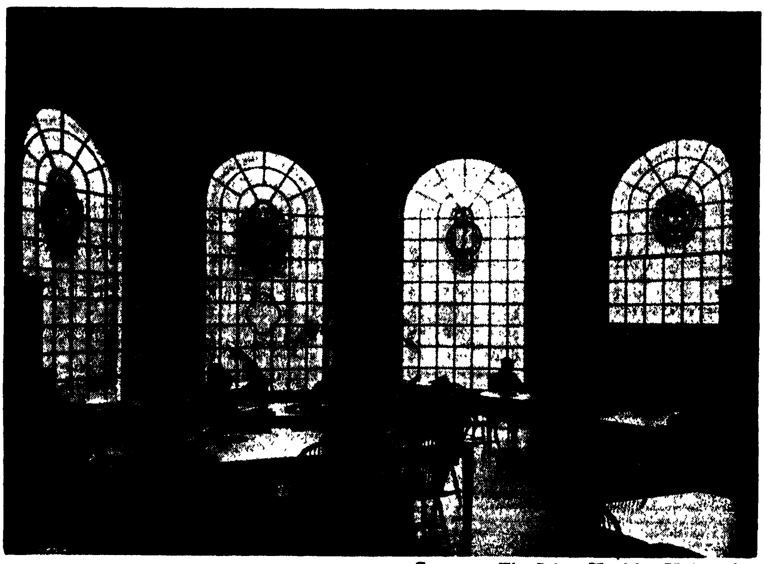
The college prospered rapidly until the American Revolution, when it suffered through loss of its endowments. General Washington used the school as a hospital during the Yorktown campaign, and the college buildings were often occupied by the contending troops. Nevertheless, the school remained in session until the Civil War, when Federal troops occupied the grounds, and a great deal of property was destroyed. Forced to close, it reopened again in 1869, but again was forced to suspend instruction from 1881 to 1888, through lack of money. In 1888 it reopened, with an annual state appropriation of $10,000, which later increased to $15,000. In 1893 Congress granted the college an indemnity of $64,000 for its losses during the Civil War.

William and Mary is coeducational; that is, it accepts as students both boys and girls. The institution now has two sections—a regular collegiate school and a normal school for training teachers. Connected with the normal school is the Mathew Whaley Model and Practice School. Although William and Mary College has never attained university size, it is famous as the birthplace of the national honorary society, Phi Beta Kappa. Among its distinguished graduates are Presidents Jefferson, Monroe and Tyler, Chief Justice John Marshall and General Winfield Scott.

The settlers of New Haven, Connecticut, in 1638 wanted to found a college of their own, but because the population in the colonies was not yet large enough to support the college already established at Cambridge, the Massachusetts Bay Colony objected. Consequently, until 1700 Connecticut sent her sons to Harvard, and bore a share in the expense of its upkeep. However, as the two commonwealths began to differ in religious concerns and political development, the desire for a separate college grew. Ten of the principal ministers of the New Haven Colony—nine of them graduates of Harvard—met in Branford and established a new collegiate school in 1700. They presented to the establishment a large gift of books, and in October, 1701, the Colonial Assembly granted a charter to the Collegiate School of Connecticut.

The ten original ministers and their successors were named as trustees, and the Reverend Abraham Pierson was chosen as rector. The first student was admitted at Pierson's parsonage in Killingworth in March, 1702. Instruction continued at Killingworth until Pierson's death in 1707. Then, in order to gain the support of towns along the Connecticut River, it was decided that the college should be moved to Saybrook. Nevertheless, although commencements were held at Saybrook, the students attended school until 1716 in the towns where their tutors resided. The college was finally settled in New Haven. At the commencement of 1718 the trustees changed the name of the Collegiate School to Yale College in honor of Elihu Yale, a native of Boston and former governor of Fort Saint George in Madras, India. The 1718 commencement was the first one held in the newly completed college building at New Haven.

In 1745 President Clap drew up a new charter which made legal the name of Yale College. Not until 1887 did the school offi-



Courtesy, The Johns Hopkins University

The graduate school of Johns Hopkins University is famous for scientific research. Above is pictured a corner of the main reading room in the library.

cially become a university. A medical department was organized in 1810, and theological and law departments were added in 1822 and 1824. The graduate school was established in 1847, and in 1861 Yale conferred the degree of Doctor of Philosophy, the first conferred in the United States.

America was growing up. More and more people were coming to the new land of opportunity, and with the increase in population came the need for more and more schools of higher learning. About 1726 William Tennent, a graduate of the University of Edinburgh, founded a school known as the Log College in Bucks County, Pennsylvania. Then, in 1739 the Synod of Philadelphia started a movement to establish a larger college for the middle colonies. However, the plan was abandoned.

Internal conflicts led to a division of the ecclesiastical council in 1742. Some of the members formed the Synod of New York and in 1746 secured from John Hamilton, acting governor of New Jersey, a charter for the establishment of a college in New Jersey. The institution, called the College of New Jersey, was opened at Elizabethtown, but moved to Newark in the same year. Its first president was the Reverend Jonathan Dickinson. Doubts arose over the validity of the first charter, and in 1748 Jonathan Belcher, royal governor of New Jersey, granted the school a second charter allowing other religious organizations to share in the college administration.

The Reverend Aaron Burr became the president in 1747, and he is credited with setting up courses of study and teaching methods in the college. (He was the father of Vice-President Aaron Burr.) The first commencement was celebrated at Newark in 1748, and in 1752 it was voted that Princeton would be the site of the new school. On October 22, 1896, the growing institution became Princeton University. Perhaps the most famous president of Princeton was Woodrow Wilson. Wilson was the first president of Princeton who was not in some way important in religious circles.

So, one after another, colleges were founded throughout the colonies of the New World. By 1776 ten such institutions were in operation: Harvard College, the College

Courtesy, Massachusetts Institute of Technology

Research work in a biology laboratory at the Massachusetts Institute of Technology, which had one of the first departments of biology in the United States.

Courtesy, Carnegie Institute of Technology

Students perform laboratory work in chemical engineering at the Carnegie Institute of Technology, Pittsburgh, Pennsylvania.

of William and Mary, Yale College, the College of New Jersey (now Princeton), the Liberty Hall Academy (now Washington and Lee University), the College and Academy of Philadelphia (now the University of Pennsylvania), King's College (now Columbia University), Rhode Island College (now Brown University), Queen's College (now Rutgers College) and Dartmouth College.

Most of these institutions were founded to promote religious interests, and especially to train ministers. Harvard and Yale were closely connected with the Congregational Church; Columbia, with the Episcopal Church; Brown, with the Baptists; and Rutgers, with the Dutch Reformed. However, some of the early colleges were started for other reasons.

The University of Pennsylvania was founded in 1740 as a charitable school. Benjamin Franklin had published a pamphlet entitled PROPOSALS RELATIVE TO THE EDUCATION OF YOUTH IN PENNSYLVANIA, and, through the efforts of citizens who had become interested in the pamphlet, the original charity school was raised to the level of an academy in 1751. The academy was so successful that two years later the proprietors, Thomas and Richard Penn, granted the school a charter. In two more years it was permitted to confer degrees and became the College and Academy of Philadelphia.

During the wars with the French, the provost, the Reverend William Smith, opposed the nonresistance policy of the Pennsylvania Legislature and was thrown into prison. For a time he received his classes in prison, but was eventually released and sent to England to raise funds. There he met the commissioner of King's College (which is now Columbia University) on the same mission. They succeeded in gaining large endowments for both colleges, and, although other troubles arose, the two schools prospered.

Dartmouth College started as Moor's Indian Charity School, founded in Lebanon, Connecticut, by Eleazar Wheelock about 1750. In 1770 Wheelock, with an ox-cart and some laborers, came to Hanover, New Hampshire, and set to work to hack down trees and build a log cabin. In this wilderness spot Wheelock hoped to find more Indians for his endeavor to turn American Indians into college graduates. Samson Occum, a full-blood Mohegan and graduate of Moor's School, toured England and Scotland in an effort to raise funds for the school. He collected some £11,000 and aroused the interest of the Earl of Dartmouth. Encouraged by this success, Wheelock made plans to enlarge the school so that both Indians and whites might be taught.

Through the influence of John Wentworth, governor of New Hampshire, large tracts of land were given to the school, and in 1769 a charter was granted by King George III to "Dartmouth College," named in honor of its patron, Lord Dartmouth. Dr. Wheelock was made first president of the institution. There have been few Indians at the college since its founding. Dr. Charles Eastman, a Sioux, was Dartmouth's most famous Indian graduate. He did much to make the country aware of the real worth of its Indian population.

The nineteenth century saw the growth of

Courtesy, University of Minnesota

The Coffman Memorial Union at the University of Minnesota is one of the most modern student recreation centers. It contains lounges, cafeterias and a record library.

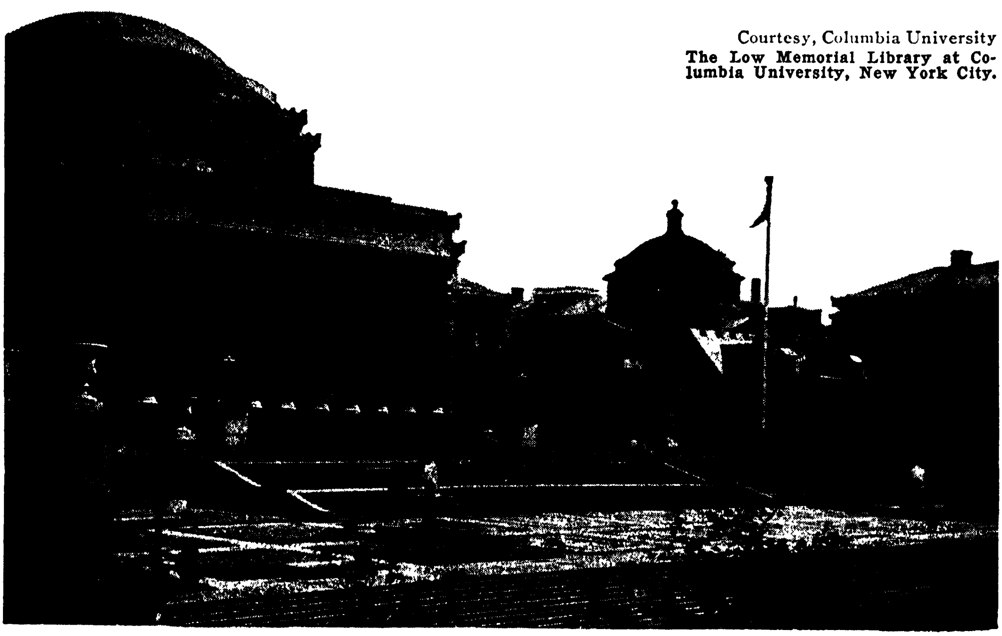
state universities. The University of North Carolina at Chapel Hill had opened in 1795. The University of Virginia was the first tax-supported institution of higher education. Tracing its beginning to an act of legislature which incorporated the Albemarle Academy in 1803, it was established as Central College in 1816 through the influence of Thomas Jefferson, who became rector of the board of trustees. Jefferson evolved a plan for its development into a state university, and in 1825 seven independent schools were opened to students.

In 1862, as a spur to education, Congress passed the Morrill Act, which set aside millions of acres of public lands for the support of colleges. These lands were divided among the states, and out of this endowment sprang numerous agricultural and mechanical colleges throughout the Union. In the meantime, all the states west and south of Pennsylvania, inspired by the University of Virginia, were establishing colleges to be supported by taxes and controlled by state officers. In some states the agricultural colleges were combined with the state universities, while in others the agricultural colleges grew into state universities. By 1878, Indiana, Michigan, Wisconsin, Minnesota, Missouri, Colorado, California, Illinois, Washington, Oregon, Kansas and Nebraska had established the beginnings of their universities. Today practically every state in the Union has a tax-supported university with free tuition or a very small tuition fee for inhabitants of the state.

HIGHER EDUCATION FOR WOMEN

Although the early institutions made no provisions for women, colleges for women began to spring up in the second quarter of the nineteenth century. It is true that there were some coeducational schools before that, but opportunities for women were so limited that the need for new institutions became clear. In 1836 Mary Lyon founded the Mount Holyoke Seminary, to put within the reach of women of moderate means educational opportunities equal to any furnished in the country. Although the school was not incorporated as a college until much later, the rights of women to education and training were near realization.

Vassar, the first school to be established exclusively as a college for woman, was the result of a man's vision. Matthew Vassar came from England as a boy and struggled to make a fortune. Given practically no instruction, the boy was forced to work for his keep. With his mother's help, six shillings and a bundle wrapped in a handkerchief, he ran away from home to find work with a farmer and a small shopkeeper. At



Courtesy, Columbia University

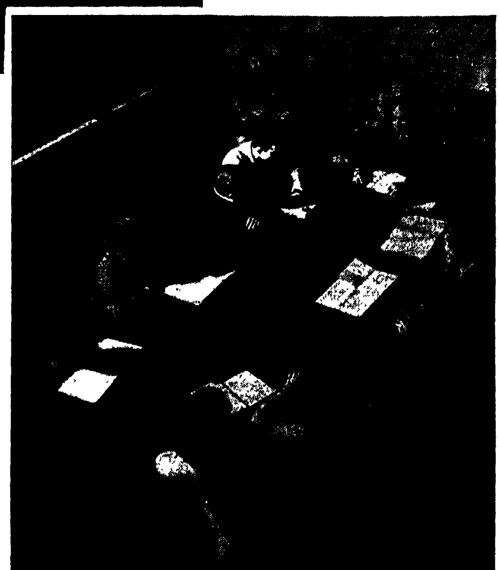
The Low Memorial Library at Columbia University, New York City.

the age of twenty, he began brewing ale and opened the first oyster and ale house in Poughkeepsie. For more than thirty years he brewed his ale, and his wealth increased. New breweries were built, and many men were in his employ. His fortune was made.

While visiting a charity hospital in Europe Matthew Vassar conceived the idea of using his money for some charitable enterprise. Milo P. Jewett suggested "a college for women which shall be to them what Yale and Harvard are to young men." Dr. Jewett worked unceasingly for this purpose, and in 1861 a charter was granted for "the first grand permanent endowed Female College in the United States." The building of Vassar College went on through the Civil War, and Dr. Jewett was appointed its president. President Jewett studied the best methods of instruction in Europe and planned for an art gallery, library, scientific apparatus and great endowments. On September 20, 1865, Vassar Female College opened. Through the efforts of Mrs. Sarah Josepha Hale, editor of GODEY'S LADY'S BOOK, the word "Female" was stricken out of the name; in 1867 the marble slab in front of Main Building was changed to read "Vassar College."

Just as Vassar was a man's vision, so Smith was a woman's dream. Sophia Smith grew up in Hatfield, Massachusetts, in an atmosphere of culture and wealth. In 1861 her brother left her a considerable sum of money. Not wanting the money and not knowing what to do with it, she sought out her pastor for advice. He suggested that she use it either for a college for women or for an institute for deaf persons. Impressed with the first alternative, Miss Smith proceeded to plan for a woman's college. Objections from the good citizens of Hatfield almost made her give up her college idea in favor of an establishment for deaf persons, but a rich man, dying, provided in his will for

Courtesy, Texas A&M College
Learning to judge cattle at the Texas Agricultural and Mechanical College. More students take agricultural courses at Texas A&M than at any other school.



Courtesy, University of Chicago
A first-year class at the University of Chicago holds a discussion. This university admits students after two years of high school, thereby making a college degree possible by the age of eighteen or nineteen.

such a school, and Sophia Smith turned back to her original plan.

Although she died in 1870—a year before the college charter was signed—her ideas had value and permanence. She wanted four things for her college—tuition equal to that

in men's colleges, study of the Bible, cottages instead of one huge building for living quarters, and men and women sharing in the management and instruction. Northampton subscribed $25,000, and it was decided to locate the school in that town. The college opened its doors in September, 1875, and is today the largest women's college in the world. Since so many graduates of Smith have been teachers, Sophia Smith has been important in the education of millions.

Courtesy, Smith College

Archery is a favorite sport at Smith College, Northampton, Massachusetts.

Although Smith and Vassar were among the largest, other colleges for women were springing up. Elmira College was founded in 1853; Wells, in 1868; Wellesley and Hunter, in 1871; and Bryn Mawr, in 1881.

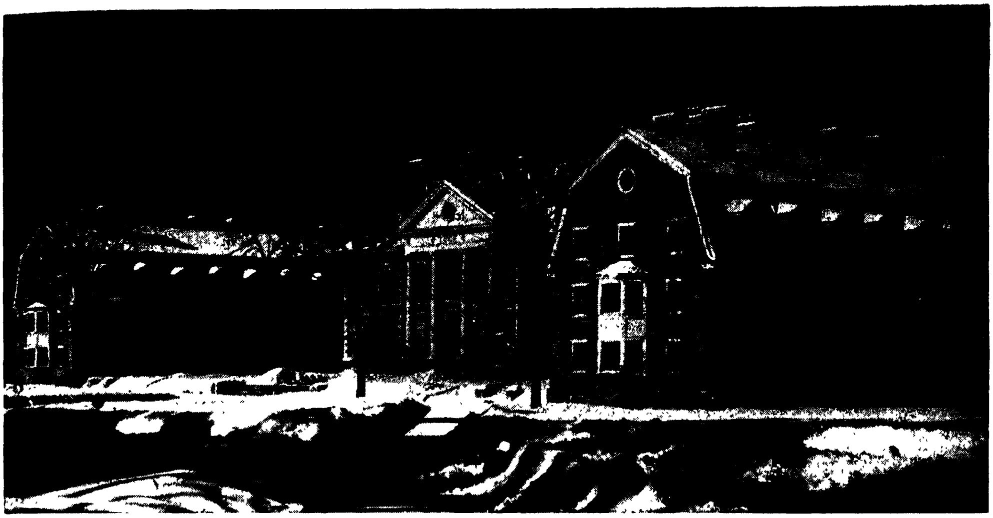
In 1887 the H. Sophie Newcomb Memorial opened as a women's college incorporated within Tulane University in New Orleans. The Women's College at Western Reserve, Cleveland, officially became part of the university in 1888; while Barnard College was incorporated with Columbia University in 1900. Although it had started as the Society for the Collegiate Instruction of Women, Radcliffe, in 1894, was authorized to confer degrees and was affiliated with Harvard University. Education for women had come a long way. These colleges for women were now on a par with the colleges for men within large universities.

Simmons College in Boston, founded through the will of John Simmons, was granted a charter in 1899 and was opened as an "institution in which might be given instruction in such branches of art, science and industry as would best enable women to earn an independent livelihood." This was a completely different type of institution from the other colleges for women, since its courses were organized for women alone, and instruction in household arts and various other purely feminine activities occupied most of the curriculum. Simmons now offers a varied course, including work in secretarial science, library science, household economics, general science, public health and landscape architecture. Skidmore, which opened in 1911, and Russell Sage (1916) are similar schools.

Western and Middle-Western state universities began to admit women as early as 1870, and eventually all tax-supported schools became coeducational or at least opened some courses or departments to women. Today there is no state university from which women are entirely excluded.

Toward the end of the nineteenth century, wealth and generosity gave birth to several individually endowed universities, as philanthropy became the vogue. Although Cornell University was originally founded on the Morrill Act, the institution was actually established in 1865 by a gift of $500,000 from Ezra Cornell, an American capitalist of Ithaca, New York. Cornell later increased the original endowment by additional gifts and by the profits on the sale of some land which he had bought for the college. Cornell is not completely an endowed institution as it receives state aid for some of its colleges, but it established a tradition for American philanthropists.

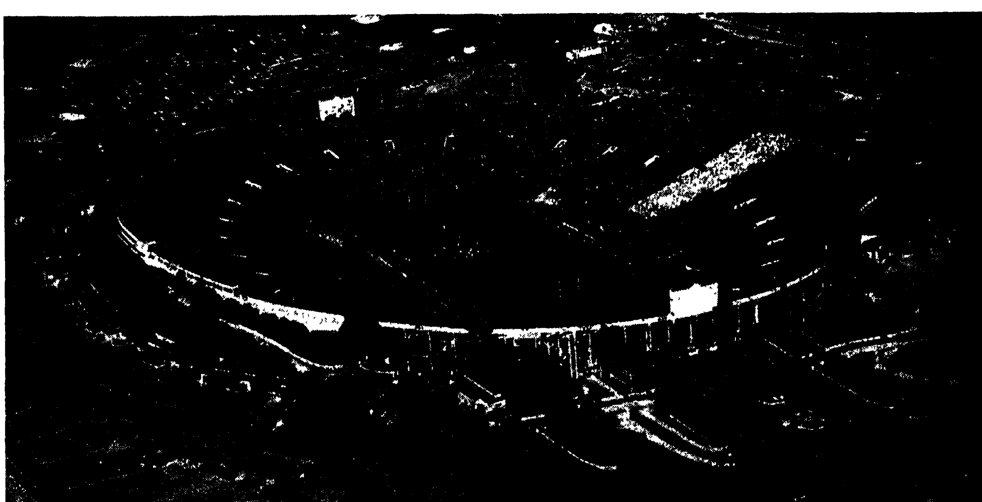
Johns Hopkins University was opened in 1876 after Johns Hopkins, a Baltimore merchant, left a fortune of $7,000,000 to be divided between the university and a hospital which would be an auxiliary to the university medical school. Senator Leland Stanford of California established Leland Stanford Jr. University at Palo Alto, California, in 1885, by a gift of 90,000 acres of land. Later the name was changed to Stanford University. John D. Rockefeller



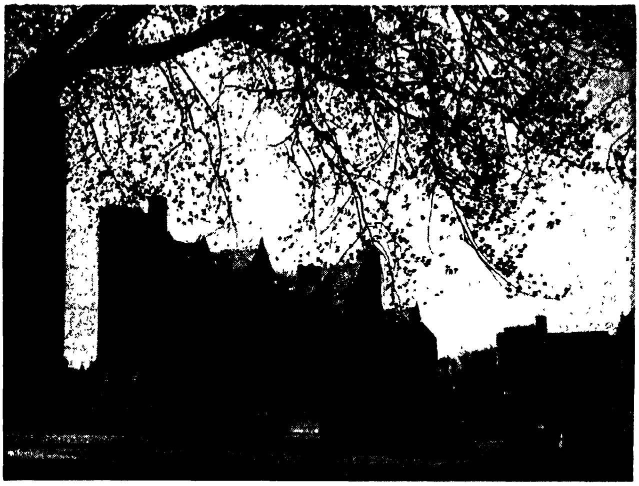
Courtesy, Dartmouth College
Winter scene at Dartmouth College, Hanover, New Hampshire. Dartmouth grew from a log cabin.

gave lavishly to the University of Chicago, incorporated in 1890; and Duke University, in North Carolina, was established in 1924 by a gift from J. B. Duke.

During the early years of American colleges and universities, students were taken from grammar schools and placed in college to train for the ministry. The curriculum (course of study) was limited to Latin, Greek, theology, rhetoric, metaphysics and some mathematics. The courses of study were quite rigid; every student had to follow a prescribed program. However, as the schools improved, entrance requirements for colleges became more and more severe, and there was a process of expansion in the curriculum. Gradually astronomy, natural philosophy, modern languages and the elements of the natural and political sciences were added. By the middle of the nineteenth century, the elective system had been introduced. By this, although certain sections



Courtesy, Spence Air Photos
The Rose Bowl game, held every year on New Year's Day at Pasadena, California, is a big event in college football.



Keystone View Co.

Georgetown University, Washington, D. C., is the oldest Catholic college in the United States. It was founded in 1789.

In the spring of 1943 specialized training programs for service men and women were started in numerous colleges and universities. Various approved institutions received contracts for programs which covered training in medicine, dentistry, chemical warfare, personnel, psychology, language training, and other types of work required by the Army and Navy. Candidates were carefully selected according to standards which were uniform throughout the country. All students followed a basic program of English, history, mathematics, physics and chemistry, after which they advanced to specialized studies. Although the most essential sections carried on, a great deal of this training was suspended in 1944 in order to send more men overseas.

The year 1943 also saw plans made to provide education for men and women who had served in their country's forces during the war. Special training and education is provided at government expense for those who desire it, provided that aptitude and diligence are displayed. Students whose college educations were interrupted may go back to their studies. Those who could not afford college before the war have been given a chance to secure a higher education.

of work were still prescribed, various new courses were established among which a choice could be made. Eventually the rights of election were extended to practically all courses. Today the only requirement of a number of colleges is a course in English composition and grammar which must be taken in the first year.

As early as its establishment in 1871, Wellesley, a women's college, opened science laboratories for students. Harvard University and the Massachusetts Institute of Technology were the only institutions to offer such work at an earlier date. Medical schools appeared in the eighteenth century, law schools in the early nineteenth, and scientific schools soon followed. Today modern universities award degrees for training in many, many lines of activity. Courses for nurses, merchandisers, farmers, school teachers, engineers and business workers are now given in colleges and universities.

The war had a marked effect on the colleges and universities of the United States. Women's and men's schools alike introduced programs of acceleration (speeding up), so that students might graduate before going to the army or industry. Most schools adopted a course of three years' length.

Courtesy, Princeton University

Nassau Hall, erected in 1756, is the administrative building of Princeton University. The Continental Congress once met here.

THE CLOUD CHAMBER

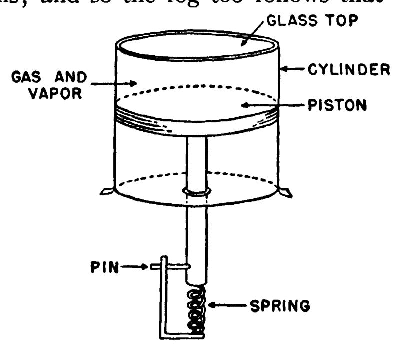
EVERY skilled workman has his set of tools with which to do his job best. A tailor has his needles and scissors and sewing machine; the carpenter, his hammer and plane and saws. The physicist in the laboratory also has his particular tools. Some are simple, such as rulers, scales and watches; some are more complicated and have special uses, such as telescopes or oscillographs, voltmeters or Geiger counters.

One of these special instruments is the cloud chamber, which can be used to make us see the passing of cosmic rays, the collision of atomic particles, and many other phenomena in atomic physics.

No one has ever seen directly an atom or any of its parts (electrons, protons, alpha particles and so on). Nor will anyone ever see them, even with the most powerful microscopes. They are all far too small to reflect light-rays toward our eye, just as a small boat on a stormy sea is too tiny to turn back any of the onrushing water waves.

Luckily, there are indirect ways of "observing" how these very small particles behave. For instance, if an electron (a tiny bit of negatively charged matter) travels rapidly through some gas or through ordinary air, it will change many electrically neutral atoms along its path into charged atoms, or ions. (Remember that this is also what happens if a charged particle rushes through a Geiger counter.) But now it so happens that moisture in the air tends to condense into fog droplets around such ions. Therefore, the passing particle may leave a streak of fog in a box or a chamber filled with moist air. By looking at that streak of water droplets the physicist can, with experience and some special gadgets, measure a surprising number of details about the particle that left the track. He can tell what charge and mass it had, how fast it traveled, where it came from and how easily it was absorbed by some obstacle in its path. That is the idea behind the cloud chamber, which is a box containing moist air or a similar mixture of vapor and gas.

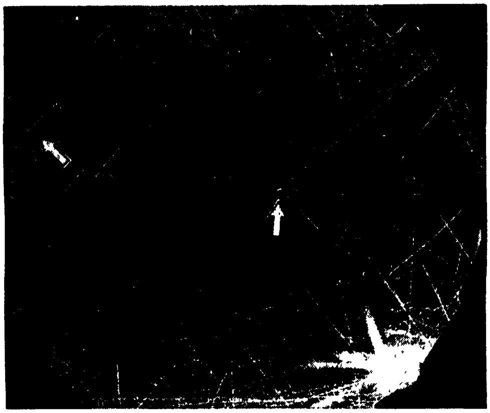
As so often happens in science, it is actually very difficult to construct the apparatus that will carry out this simple idea well. For instance, the fog tracks can form only if there is the right amount of moisture in the air. There must be just as much as the air can hold. If there is too much, it will settle out by itself as dew or rain. The Scotsman C. T. R. Wilson first showed how to get these critical proportions just right: water vapor—or better yet, some vapor like that of alcohol—is released in the air or other gas in the cloud chamber. The vapor is absorbed in the gas—that is, it seems to disappear without leaving a trace of cloud or fog. The bottom of the chamber can move like a piston in a cylinder. When the piston is pushed down, the gas has more room, so it expands. (See the diagram.) This cools the gas. But the cooled gas can not hold as much vapor as before, and so the vapor will be ready to form fog or a little cloud. Where can such a cloud begin to form most easily? On ions left in the wake of a passing particle. A charged particle, perhaps an electron, speeding through the chamber just before the expansion, will have left along its path a narrow line of ions of the gas atoms; and so the fog too follows that line.



A diagram of a cloud chamber. If the pin is pulled to the left, the spring quickly draws the piston in the chamber down. Then the gas and vapor expand and therefore cool.

Careful experimentation has shown how to build good cloud chambers by selecting proper gases and vapors, adjusting the speed and extent of the expansion, and so on.

Usually one makes photographs of the "tracks" just after the expansion, before the fog has a chance to disperse again. From these one can then measure how far the particle traveled in the chamber before it was absorbed by the gas inside. Alpha particles, released perhaps by some radioactive material placed inside the chamber, will travel less than two inches. But specially



© Acme

The "stars" to which the arrows point in this cloud-chamber photograph are the tracks of particles which were thrown off as the nuclei of two atoms broke up.

swift electrons may pass through the whole apparatus without being absorbed. To test this absorption better one often puts heavier materials like lead screens into the chamber and notes how the tracks are affected by them. This will tell how powerful and penetrating the rays were, how much energy they possessed, and how fast they went.

Another clue is the thickness of the fog trails. Fast-going electrons, which have not much charge or mass, leave relatively few ions in their paths, hence their cloud streaks are thin and feeble. But heavy, slow alpha particles can knock many gas atoms down into ions before they are too weakened to move farther—so their tracks, though shorter, are fat and heavy with thick fog.

A last way of getting information about the particles sent into the cloud chamber is also a very pretty one. If the chamber is put between the poles of a powerful magnet, then speeding particles which carry an electric charge are bent from their path. This reveals their mass, speed and energy; and this is also the nicest way to discover whether the charge is positive or negative.

Now and then a cloud-chamber picture may show the rare collision between a particle, say an alpha particle, and an atom of the gas in the box. The "breakage" that flies about after such an encounter will make distinctive tracks of its own. So we can even "see" with the aid of the chamber the changing of an atom that has been hit by a particle.

As we have seen, the gas in the chamber can be ionized (transformed into ions) by charged particles—electrons, positrons, protons, alpha particles and mesotrons. To some extent, the gas can be ionized also by uncharged neutrons, and by all kinds of so-called "pure" radiation. Among these kinds of radiation, or pure waves (energy in the form of "photons"), are X rays, gamma rays and light. But such radiation usually makes no tracks of its own in the chamber, and is not at all affected by a magnetic field. However, it *does* show up sharply when it is allowed to fall on some target in the chamber. Then a whole shower of particles, mostly electrons, is knocked out of the target material and sets up its own tracks.

The most beautiful showers are made by cosmic rays. Indeed, there is no tool which can take the place of the cloud chamber in the study of that mysterious, powerful radiation which comes to our earth continually from high up in our atmosphere and the space beyond. Two of the many different kinds of particles which make up cosmic radiation were first discovered in cloud-chamber pictures—namely the positron (a positively charged electron) and the mesotron (a positive or negative particle, many times heavier than the electron). The second of these, the mesotron, is very penetrating; that is, it is not easily absorbed by matter. The other particles (positive and negative electrons and protons) and the very high-frequency waves, all of which together make up cosmic rays, are more easily absorbed by matter and make the showers which can be seen with the cloud chamber.

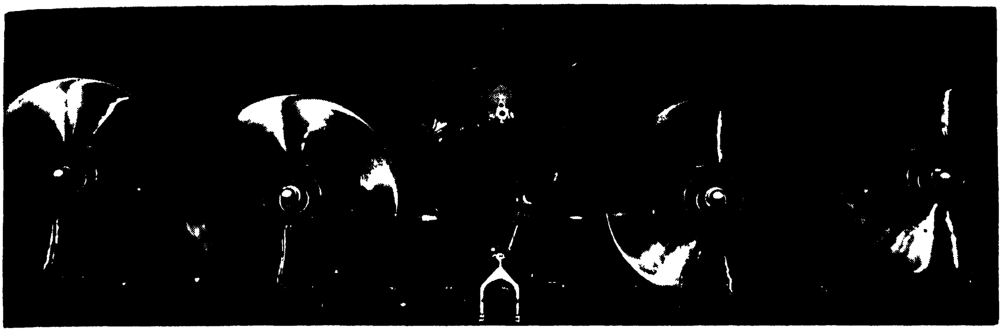
HOW "PURE" ENERGY MAY BE CHANGED INTO MATTER

Some photographs taken with the cloud chamber may show very astonishing tracks. They seem to be telling us that both the mesotrons and those high-frequency waves (or "photons") in cosmic radiation can change suddenly into other rays. For instance, mesotrons may change into electrons and other rays. An electron and a positron may be created when a photon of a cosmic ray suddenly disintegrates (falls apart). This is how "pure" energy, as represented by a photon, changes into matter, namely, into two particles!

The theory for all these phenomena is still quite complicated and unfinished. But some of our greatest physicists are at work in this field, which may soon open further secrets of atomic structure and atomic energy. Here, too, the cloud chamber continues to be one of their most helpful tools.

By GERALD J. HOLTON.

THE NEXT STORY OF SCIENCE IS ON PAGE 4529.



Are There Traffic Rules in the Sky?

YES, there are many traffic rules that must be obeyed in flying so that accidents will be avoided.

Let us suppose that you are the pilot of a plane going from Chicago to Denver.

"NC 52473, off the ground at 10:30." With the words of the radio operator in the Chicago airport tower buzzing in your earphones, you lift the nose of the plane toward the sky.

Planes are called by number and not by name. So, whenever a station calls you, the number of the plane—in this case, NC 52473—is used to make contact.

The meteorologist—weatherman—at Chicago forecast clear skies as far as Omaha and a slight tail wind, which will help push you forward. That means you will have what is known as contact, or good visibility, flying weather. When the weather is bad, blind flying—by instruments—is necessary.

You will fly to Denver on airways. This means that your plane will roar along an invisible highway in the sky, as a car travels over a road on the ground.

An airway is a path through the air. It is "marked out" by radio beams in order that pilots may find their way more easily. It has light beacons to guide planes at night; radio fan markers, which are signposts that tell distance on your aerial highway; emergency landing fields, and other flying aids.

These roads in the sky crisscross the North American continent, linking the most important places. Often an airway is not the shortest way but is the easiest and safest.

Airways are given names and numbers to tell them apart. For example, you leave Chicago on Red Airway Number 12, then turn into Green 3 and finally arrive in Denver on Red 6. Green and Red airways carry traffic in a general east-west direction, and Amber and Blue run generally north and south.

As you head away from the airport you tune in on the Chicago radio-range station. This is a special radio station which sends out code as shown in Figure I (a).

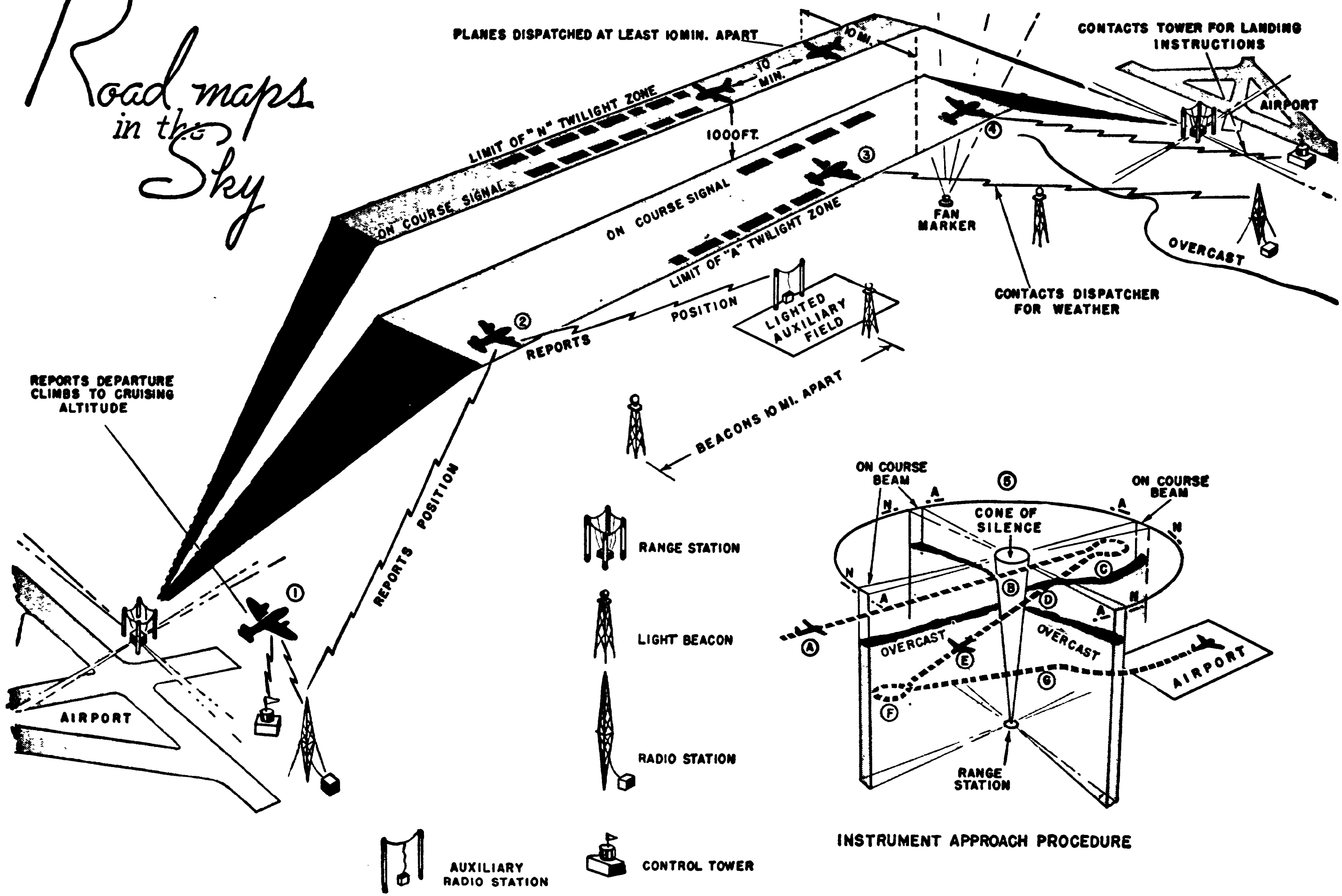
Suppose you are flying in Area One. This is known as a quadrant because it is one-quarter of the total circular area around the station. You hear an A signal in your earphones—dit-dah (•—)—in code. The next quadrant gets an N code sound—dah-dit (—•). The third quadrant gets another A and the fourth another N, as in Figure I (a).

Where an A quadrant and an N quadrant overlap a little, however, the dit-dah (•—) of the A joins with the dah-dit (—•) of the N. The combination of these two sounds at the same time makes you hear a solid hum (———). See Figure I (b). This hum indicates the center of the beam; it is the on-course signal, the middle of the highway.

Just as in automobile traffic, everybody keeps to the right side of the road. Up in the air you may even fly five miles from the center of the highway. In this way the chances of hitting another plane head-on are cut down.

You have many other safety rules, too, although some of them must be obeyed only when a pilot is flying blind. Planes flying in opposite directions on airways fly 1,000 feet apart in altitude. A northeastward flight from Ottawa to Quebec could be made at 5,000 feet or 7,000 feet or at some other odd-thousand altitude. Going the other way, you would fly at 4,000 feet or 6,000 feet or at some other even-thousand altitude.

Road maps in the Sky



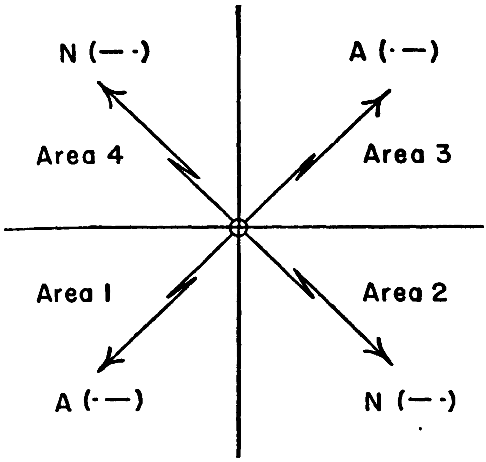


Fig. I (a)

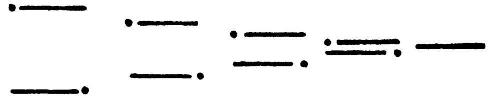


Fig. I (b)

Planes going the same way at the same altitude must be ten minutes flying time apart—about thirty miles for average planes.

Flying speed must be kept the same under most circumstances so that one plane does not overtake or fall back on another. Regular reports on location have to be made, and an alert watch must be kept for incoming radio messages.

Flying southwestward on Red Airway 12, you proceed far enough to tune in on the next radio beam as Chicago falls behind. This second beam, or range station, is located at Moline, Illinois. Turning the plane slightly to the right (trace the course on Figure II) you line up with the Moline beam, then with the one at Des Moines, Iowa, and finally with the Omaha station.

After gliding in to a smooth landing at Omaha, you have the plane serviced with gas and oil while you visit operations. This is the headquarters for business at the field; here you check in and out, get weather information, look at maps, get permission to take-off and so on.

The meteorologist says that there will be heavy clouds on the route to Denver; you will have to fly on instruments.

In your final check with operations you are given the 10,000-foot level for your flight on the airways. You push throttles forward, gathering speed as you roar down the runway. Then, back with the stick and you are airborne.

NC 52473, off the ground at 15:20. This is 3:20 P.M.—12:00 plus 3:20—by the twenty-four-hour time system.

Soon you are at 10,000 feet, your flight altitude. Westward you soar, tuning in and reporting to the various radio-range stations along the way.

The Denver radio tells you that you will have to make an instrument approach—blind flying with precise maneuvers—right to the airport itself along the invisible roads which radio creates.

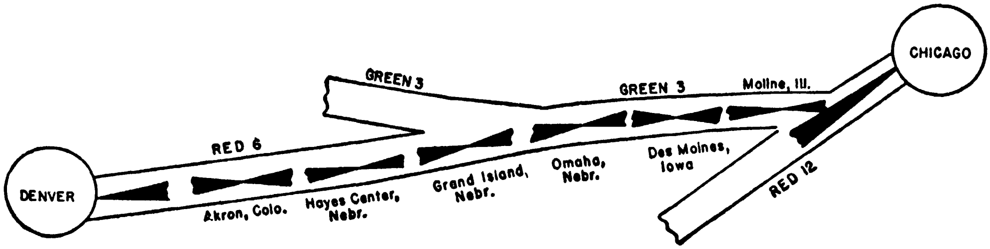
Sometimes when there are many planes all trying to land by instruments at the same time you may be stacked. When planes are stacked, they fly at altitudes 1,000 feet apart (usually above or near the airport) while the planes at the bottom of the stack land, one by one. As a plane lands, everybody moves one closer to his turn for landing.

Back and forth along the legs of the beam you go, in definitely timed maneuvers, using the cone of silence as a point from which to measure time.

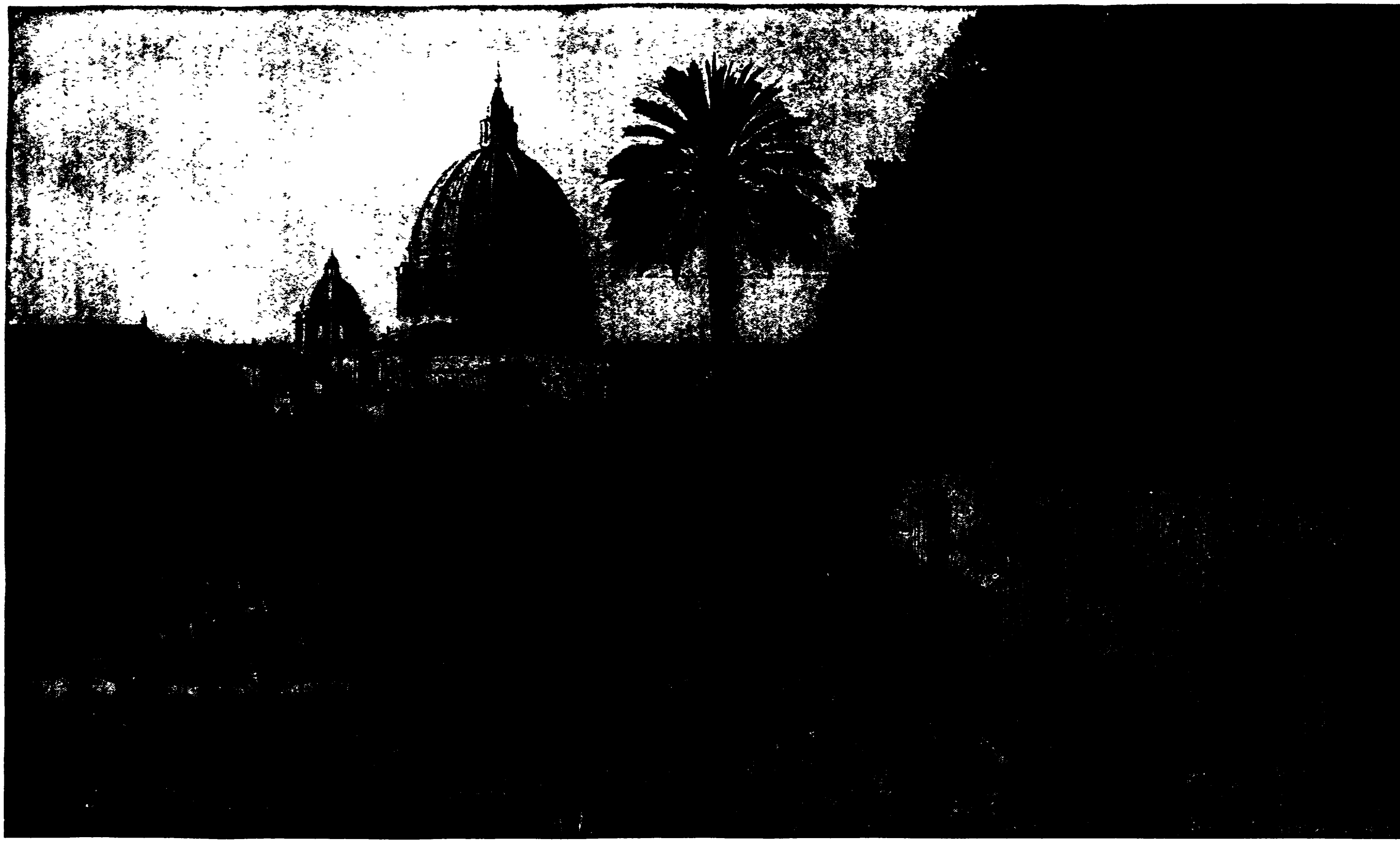
The cone of silence is a spot in the air directly over the radio-range station. Here all code signals fade away and, just for the moment that you pass, there is silence. So, as you fly in on the beam, you know that you are directly over the station when the beam's hum dies out.

You guide the plane down; the wheels touch the concrete. The sky highway has led you to your destination.

THE NEXT WONDER SECTION IS ON PAGE 4397.



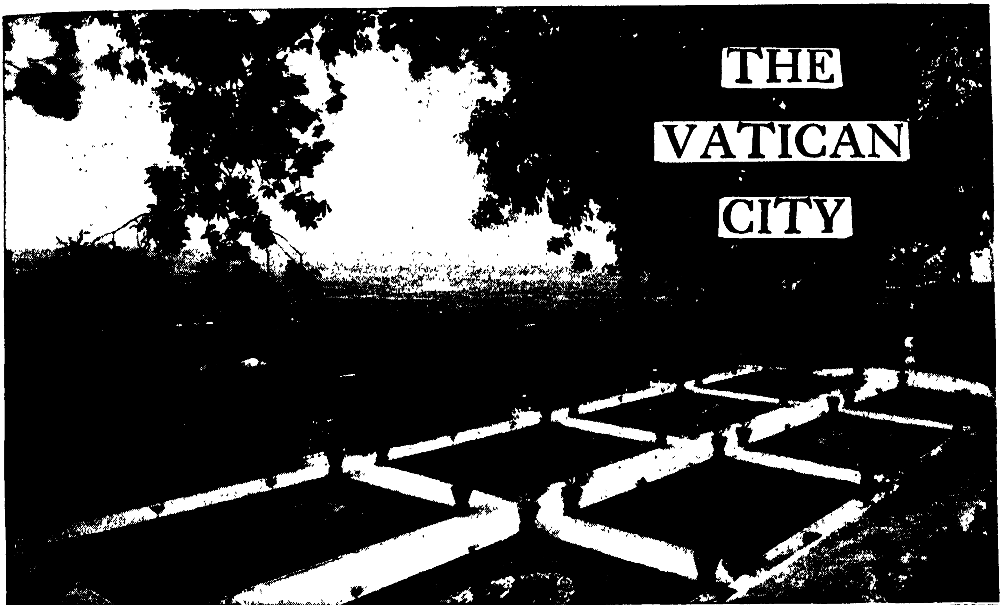
DOME OF ST. PETER'S SEEN FROM THE GARDENS OF THE VATICAN



© Anderson, Rome

The Vatican Gardens are laid out in sixteenth-century Italian style. Statuary and shrines adorn walks and groves; everything is arranged to produce stately harmony. Among the many treasures of the gardens is a reproduction of the Grotto of Lourdes, donated by French Catholics to Pope Leo XIII. Through the gardens runs part of an old wall built by Pope Leo IV. It includes three great towers; and here the Vatican Astronomical Observatory is installed.

THE VATICAN CITY



Courtesy, ENIT

Gardens of Castel Gandolfo

IN addition to their spiritual rule over the millions of Catholics in the world, for over eleven hundred years the popes were also temporal rulers of a broad band of territory stretching across Italy. This territory was known as the Papal States, or the States of the Church. They originated in a gift of Pippin (or Pepin) the Short, king of the Franks, made to Pope Stephen II in 754. Much of the territory had been taken from the Lombards. Italy was at that time divided into several separate states.

This territory was later enlarged and sometimes some of it was lost, but at the time of the French Revolution, the Papal States were almost the same as at the time of Charlemagne. During the French Revolution France annexed part of the Papal dominion, and later overran all Italy, setting up republics in place of some of the separate monarchies. After Napoleon rose to power, he annexed the Papal States and removed Pope Pius VII to France. In 1814, when Napoleon's power had waned, the Pope returned to Rome.

The Congress of Vienna, called to settle the affairs of Europe, restored the Papal States in 1815, and divided the remainder of Italy into six small states, four of them under the influence of Austria, and all under autocratic rule. Slowly the sentiment for democracy, and for a united Italy, grew. In 1848, the attempt to drive Austria from Italy was made and a republic was set up in Rome. This was overthrown by France, which became the defender of the Pope and kept troops in Rome.

The movement for a united Italy continued, however, and the King of Sardinia put himself at the head of the movement. In 1859-60, much Austrian territory in Italy, some of the Papal States and all of Southern Italy were added to his dominions. France was unwilling to see the Pope dispossessed of his territories, however, and prevented the annexation of the Papal States. Nevertheless, in 1861, the King of Sardinia began to call himself King of Italy. The war between Austria and Prussia in 1866 enabled Italy to secure Venice from Austria. Only Rome and the territory around the city were left outside the kingdom of Italy.

The Franco-Prussian war in 1870 compelled Napoleon III to withdraw his troops from Rome, and the Italian forces marched in. The next year Rome was made the capital of united Italy. Parliament attempted to make peace with Pope Pius IX, by giving him rule over the Vatican and Lateran Palaces, a pension of about $685,000 a year,

also recognizing his right to send and receive ambassadors. The Pope declared these acts put the Papacy at the mercy of the government, made the Pope in fact a "prisoner" in the Vatican. He refused to accept the pension, and until 1929 no pope left the Vatican grounds.

THE ESTABLISHMENT OF VATICAN CITY

On February 11, 1929, Mussolini made a treaty with the Pope, recognizing him as the independent sovereign of a tiny independent state to be known as the Vatican City, and paid over a large sum as compensation for the lost territories. The State includes St. Peter's, and the square in front, the Vatican and the Lateran Palaces, with the beautiful Vatican gardens, Castel Gandolfo, which is separate from the Vatican, and several other buildings in and around Rome. The area of the tiny state is about 109 acres. It includes also a small railway station, a radio broadcasting and receiving station, and a post office. Vatican City issues its own coins and postage stamps, and has its own police force. The ordinary population is a little more than a thousand. The Vatican territory by the treaty is always to be considered "neutral and inviolable."

In theory the Pope is an absolute sovereign, but in practice he delegates the executive power to a governor who is charged with maintaining order and represents the Vatican in ordinary dealings with the Italian government. In important matters, and in dealing with other governments, the Pope is represented by the Papal Secretary of State. The judicial power is exercised by a special Tribunal of First Instance and two courts of appeal.

There is a tiny armed force, the Pontifical Armed Corps, made up of four distinct groups. The most famous of the groups is the Swiss Guards, which go back far into history and still wear their picturesque sixteenth century uniforms.

WHERE AGE-OLD TRADITIONS ARE CARRIED ON

The Vatican City, then, is an independent state, as much so as England, France or the United States. Yet it is not as an independent state that it draws countless thousands from all over the world. To pious Catholics, it represents the seat of the Papacy, the headquarters of the Catholic faith. Here dwell the Pope himself and his pontifical family—palatine cardinals (those living in the Vatican palace), papal secretaries, domestic prelates and others. Here is carried on the immense work of administering the Roman Catholic Church. As for the religious ceremonies of the Vatican City, they maintain the age-old traditions of the Catholic Church. Perhaps the most impressive of all these ceremonies takes place when from the central balcony of the Basilica of St. Peter, the Pope blesses the countless thousands of worshipers gathered in the square.

The Vatican City also attracts great numbers of non-Catholics. To Catholics and to non-Catholics alike, it offers countless artistic and literary treasures. It has been said that a whole lifetime would not suffice to examine thoroughly all that is worth seeing in the Vatican City.

MARVELS OF THE VATICAN CITY

Among these is the Basilica of St. Peter, the most famous church in all Christendom; we have described it on pages 6309-10. There is also the immense Vatican Palace, which includes the old and new palaces of the popes, the Sistine Chapel and many smaller chapels, the galleries which show paintings and sculpture, the museums and the library. The Sistine Chapel contains some superb frescoes by Michelangelo, including the Last Judgment, his most famous painting. The picture gallery has masterpieces by Giotto, Fra Angelico, Botticelli, Raphael, Titian and many others. As for the various museums of the Vatican, these contain undoubtedly the most complete collection of antiquities and masterpieces of art in the world—Egyptian statues and papyri, Etruscan vases and tombs, Greek and Roman sculpture, including the group of the Laocoön, the Apollo Belvedere and other works of art.

For booklovers there is the fine Vatican Library, with its 500,000 bound volumes and 60,000 manuscripts. These last include rare old works in Arabian, Armenian, Greek, Latin and other languages. Perhaps its most priceless treasure is the so-called Codex Vaticanus, containing most of the Bible. This is probably the oldest vellum manuscript in existence. It dates from the fourth century. In 1928, The Carnegie Endowment for International Peace aided in making a new and modern catalogue of the treasures of the Library. It is now as convenient and well-equipped as any of the great libraries of the world.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 4352.

Four beautiful copies of statues of the time of Praxiteles.

THE FOLLOWERS OF THE GOLDEN AGE

WE are told that in the age of Phidias the flood of Greek art rose to a stupendous height and afterward slowly receded, finally leaving generations empty of greatness, like a barren, shelving beach. And we know that there is something in the nature of genius very much like that of a sea driven by mysterious tidal forces.

Why is it that the art of Phidias is acclaimed the greatest thing Greece produced? It seems as if for a period of about two hundred years a sculptor in Greece could not touch anything without making it beautiful. At first thought there appears not to be much difference between the work of about fifty years before and fifty years after the Phidian age.

We shall understand better if we remember that art is measured not so much by the technical work done by the artist's hands as by the thought that inspired him to do it. *Greek sculpture touched its pinnacle in Phidias' spiritual ideal of the pagan deity.* He could not show the gods in any other than a human form, because that is all a mortal can do. But in his statue of Zeus, the father of the gods, he showed a picture of greatness that no other Greek artist was ever able to give. When people saw it they felt that all the grandeur of justice and goodness and truth belonged to Zeus. In the gods as Phidias presented them there could be nothing so small as jealousy and revenge, qualities that appear freely in the gods and goddesses of Greece in later art. And Phidias' ideal reflected the thought of Athens at its purest and noblest.

This same ideal touched portraiture in general. When the Argive sculptors made a statue of an athlete and labeled it with the name of a victor, they did not trouble, except in certain cases, to make it a portrait. This was not due altogether to casualness: it was surely a greater reward for a sculptor to take all the grace and strength that belong to the ideal runner or wrestler and mold them in the form of a man as a reward for an athlete, than to render an actual portrait of a single athlete who had enough of those qualities to help him once or twice to win a race.

And there were famous portraits, like that of Pericles, probably by Cresilas, a Cretan sculptor who worked much in Athens. A copy of this bust is in the British Museum, and we can see for ourselves how the sculptor has seized on the abstract, impersonal virtues that lie behind

great statesmanship and shown them in a head which happened to be physically something like that of Pericles.

In addition to its spiritual ideals, the temper of the age—the age of Greece in reaction after the Persian Wars—had much to do with the standard of its art. The people thought in terms of the nation; they were not concerned with selfish interest; their interest was given for the good of the State. And naturally the greatest work was done by sculptors thinking of Athens and Greece rather than of their own glory. When the State said, "Build me a Parthenon for the glory of Athene and of Athens," that temple was nobly built. But when, after a while, some man said, "Make me a grand statue of Athene, and I, being noble and generous, will give it to the State," then something less noble crept into the work; for the sculptor must try to please the man who was spending some of his wealth on Athens, and so he would think less of the work itself than of the effect it would have on his patron.

THREE GREAT SCULPTORS IN THE ART OF OLD GREECE

That largeness of mind that grew when Athens was the chief power of Greece and could be said to contain within herself all that there was of strength and grace, lasted for a time even after the Peloponnesian War, which took place between 431 and 404 B.C. In this war Athens was beaten by Sparta, and could no longer claim to be the prime power.

Three great names out of a large number of worthy sculptors such as Silanion, Euphranor, Timotheus, Bryaxis, Leochares—whose work was recorded by ancient writers and freely copied by the Romans—dominate the fourth century of Greek art. They are Praxiteles, Scopas and Lysippus. A little before them we have a glimpse of Cephisodotus, sometimes called the father of Praxiteles, sometimes the elder brother, but generally accepted as his master.

The chief work of Cephisodotus, which has been preserved by means of a good copy, was done in bronze about the year 370 B.C. It was a statue of the goddess Irene (peace) holding the infant god Plutus (wealth) in her arms. The marble statue copying the original is in the Munich Museum. In this statue there is nothing of the grandeur of godhead that in the figures made by Phidias so affected the religion of the day; but there is something simple and dignified in the proportions, the pose and the treatment of drapery that remind one of Phidias. Like many other statues, this figure was cast on one of the coins of the day, and from that and other sources, among them the play called Peace, by Aristophanes, the Greek writer, we know that Cephisodotus' conception of the goddess of peace was a good and true one.

THE ENDURING FAME OF THE NOBLE WORK OF PRAXITELES

If six ordinary educated persons in six modern countries were asked to name the most important Greek sculptor, they would probably say Praxiteles, for Praxiteles has had more popularity than any other sculptor Greece produced. His work was regarded with something like worship by the later Greeks and by Romans, and this weight of popular opinion has influenced the judgment of nations who followed those people. The chief reason is that the work of Praxiteles was far more easily copied than that of Phidias, who was a greater genius.

A poor copy of a statue by Phidias could easily become an absurdity, because there was a spirit underlying the dignity and severe magnificence of the original which no copyist could ever reproduce. Phidias did not give the inferior mind so much to take hold of. His soul dwelt eternally in the clear, upper air, and that cannot comfortably be breathed by dwellers on the plain.

THE MASTER TOUCH OF PHIDIAS, KING OF HIS AGE

It would seem, in a way, that the farther we get from Phidias the nearer we get to him. By this we mean that in later Greek art we are always meeting with new weaknesses, and looking back and saying, "That is another sin of which Phidias would have been incapable." The work of the men who came after, led to a certain extent by Praxiteles, was more luxurious, more free and less heroic. The lines curved more; instead of "How magnificent!" people said, "How delightful, how graceful!" The gods and goddesses of the fourth and third centuries B.C. were more complacent, more easily lived with. They could be understood better, were at times happy or unhappy, jealous or generous, forgiving or revengeful—were just like human beings, except that they happened to be gods; whereas

the gods of the Phidian age made their worshipers continually conscious of the pettiness of human endeavor and feeling and so kept men's souls in a state of growth.

Praxiteles was born about 380 B.C., and his work covers the best period of the fourth century. We are fortunate in having a statue actually made by him—no copy, this time. It represents the god Hermes with the baby Dionysus on his arm. The sculpture is in Parian marble—that is to say, marble quarried from the island of Paros. It is thrilling to learn that the statue was found in modern times by German excavators in the temple of Hera, at Olympia, in exactly the spot as described by Pausanias, the historian of long ago, who is the friend and guide of beauty-lovers to-day. The Hermes is now treasured in the museum at Olympia.

Art historians have learned a

A copy of the beautiful head of the Aphrodite of Cnidus. By Praxiteles.

Spinario—the boy with the thorn in his foot—a sculpture of the time of Praxiteles.

great deal from this statue. It would seem that Praxiteles at his best was not so far removed from the Phidian age as the copies that exist of other works by him would lead us to believe. There was something of the serene and still strength of the great years in Praxiteles, and to this poise he brought a grace of his own. His mastery of the technique of marble sculpture was unequaled in Greek art. Sculptors who were attracted by the technique to try to copy him reproduced the loveliness, the suavity, the "exquisiteness" to a certain extent, but if they could have learned his whole secret of greatness they would not have stopped at being copyists.

The Hermes shows a god who was great and noble, but had that indefinable quality of charm which it seems somewhat unnecessary and superfluous to give to gods, and which we think

of as more a feminine than a masculine attribute. The statue is familiar to us through photographs and casts. Like the Discobolus and the Venus of Milo, it is well known to all who have made any study of art. But even the most delicate photograph can in no way show the marvelous treatment of the original marble: the fine texture of the skin and hair, the working of the muscles, and the superb handling of the drapery. The Greek writer and critic Lucian, who saw the Hermes before Olympia became a ruin, said that in the treatment of the head Praxiteles excelled all that had been done before.

This genius in execution marked all the work of Praxiteles, and was doubtless one of the reasons why ancient writers spoke so much of one of his statues of which only mediocre copies now exist. This was the Aphrodite of Cnidus, regarded by some ancient writers as the most beautiful statue in all Greek art. It shows the goddess about to enter the sea, or perhaps the bath, and we are led to believe that in comparison with it the Hermes was a minor work. The best copy of the Aphrodite is in the Vatican. A beautiful head, also of Aphrodite, if not by Praxiteles, by a gifted follower, is in the possession of Lord Leconfield, in London. But, of much of Praxiteles' work described by ancient writers no trace exists.

There is a story that a friend of Praxiteles, having tried in vain to learn what he considered was his best work, resorted one day to strategy and told him that his studio was on fire. The sculptor, in sudden horror, said that if the Eros and the Satyr were not saved, his best work would be lost.

THE BEAUTIFUL STATUE THAT DREW THE PEOPLE UNTO IT

His statue of Eros, the boy-god of love, was presently set up in Thespiæ, and we are told that people journeyed to the town simply to look at the statue by Praxiteles. It is lamentable that no copy exists. The Satyr, or faun, was later set up in the Street of the Tripods at Athens, and several copies have been found; the best known of these is that in the Capitol, Rome. But lately a torso has been discovered—it is now in the Louvre—and this some experts are inclined to believe is the original Satyr.

Several copies of other groups by Praxiteles, such as the Silenus, the Artemis, the Zeus, were made in Roman times, but we know how miserably they fell short of the originals. There was one group, the Niobe, which has excited much interest among writers from Pliny downward, as it is difficult to say whether it was the work of Praxiteles or of his contemporary Scopas.

It shows Niobe and her children suffering the vengeance of Apollo and Artemis because she has boasted of her seven lovely sons and seven lovely daughters. Apollo slays the seven boys in the forest, and the arrows of Artemis (the Roman Diana, the huntress) find the girls one after the other, even to the last, whom her mother in inexpressible agony is shielding. Then the high gods take pity on Niobe as she stands there stunned by the final blow, her face uplifted and quivering, and they change her into stone, thus saving her from her own agony.

THE MEN WHO SCULPTURED THE PETTINESS OF THE GODS

This dreadful tale of petty feeling on the part of the gods was the subject of much sculpture in the later years. Many statues of the "group of the Niobids" have been found, some in Florence, some in Rome. A very fine one, the best of the group, now headless, showing one of the daughters of Niobe, is in the Vatican. It is called the Chiaramonti Niobid. Another, of one of the sons, is in the Uffizi in Florence. In that same gallery is the most pathetic of the marbles—from the point of view of the story—showing Niobe shielding her last child from the arrows of Artemis.

Scopas did not win as much regard from ancient writers as Praxiteles did, and the list of his recorded works is shorter but perhaps that was because Praxiteles was a favorite, and also because by the nature of his sculpture Scopas is limited. Like most of the Greek artists, his work is concerned with the pagan religion, the wars and struggles between the favored of the gods and their enemies. In place of the serene immobility of Phidias and the grace of Praxiteles he strove to show wrath and passion and strength in the faces he cut.

This is a very great advance on the mask-like faces of the early Greek sculpture, and somewhat prepares the way for the distorted countenances shown in the

work of later and decadent years, when it seemed that a sculptor set himself to show how much emotion it was possible for marble to reveal, and in so doing went beyond the bounds of his medium and also of good taste.

THE VIGOROUS WORK OF SCOPAS THAT IS LEFT TO US TO-DAY

Of these excesses Scopas was never in the least guilty, and he was responsible for the best of the more vigorous kind of sculpture in the fourth century. The fragments of his work left to us are partly connected with the temple at Tegea, in the Peloponnesus, and partly with a monument to Mausolus, in Asia Minor. The pediment statues at Tegea formed excited groups representing contests. Two of the heads are preserved in the National Museum of Athens, and they tell in themselves the tale of the development and originality of Scopas.

One of the reasons for the mask-like appearance of Greek faces in the fifth century had been the undeviating, smooth oval, and the prominently drawn eyes. It seemed as if the classic sculptors looked on the eye as the most important feature of the face, and therefore they made the eyeball a little too important. The upper eyelid was always cut with infinite care, and the joining of the upper and lower lids treated in a traditional, careful way.

For many generations eyes were sculptured in this manner as a matter of course. Scopas was the first man to realize in his work the fact that the play of the surrounding muscles, and the depth to which the socket was sunk under the brows, were of far more importance, from the modeler's point of view, than the actual eye and eyelid. Scopas also was the first sculptor to show men's faces rather square than in pure oval.

If we look at the faces we see around us, and, trying to forget the color of the eye and eyelashes, take a good look at the surrounding muscles, noticing the difference they make in showing anger or longing, we shall perhaps understand something of the thought of Scopas. And it may seem strange to us, accustomed as we are to all kinds of most expressive painting and sculpture, that eyes should not at the outset have been treated in this way. But the artists who make these expressive faces are in art the heirs of all the ages, and there is not a single problem in painting or sculpture that has not been solved for them, many times over; whereas the Greeks were the inheritors of nothing save a faint tradition of Egyptian art and the art they had evolved for themselves.

This problem once solved, Scopas found many artists to follow him, and his influence on the succeeding generations, as we have said, was great. Like other sculptors, he made many single statues, and though they are described by ancient writers, for the most part they are lost. The group we should most like to have seen, said by Pliny to have been worthy of a lifetime's labor, was a group of gods and goddesses, sea-nymphs, Tritons and dolphins. The sculpture told of the carrying-off of Achilles by his mother Thetis to the Isles of the Blest.

Another wonderful statue was the Apollo Citharœdus, of which a copy exists, or perhaps a statue imitating it, in the Vatican. In the British Museum is a seated figure of Demeter mourning for her daughter Persephone, who was taken away by Pluto to the underworld. This statue, made by a sculptor influenced by Scopas and Praxiteles, shows a picture of dignified and restrained grief, and reveals something of the effect Scopas had on his fellow-artists.

THE FAMOUS MONUMENT SET UP AT HALICARNASSUS

In later times this restraint would not have been possible. The exquisite taste of Greek art in the great years and those immediately following is nowhere more marked than in the innumerable stones called stelæ set up in Athens, in the Quarter of the Tombs, to mark the resting-places of the dead. A whole book could be written on them, on the shyness of sorrow in the mourning figures, the dignity of their grief. It would seem that in this sphere, as in many others, Attic art said all that could beautifully be said, and the rest of the world's work since is but a more or less clumsy imitation.

Scopas collaborated with three other sculptors—Bryaxis, Leochares and Timotheus—and with Pythius the architect-sculptor in the making of the famous monument at Halicarnassus, in Asia Minor. It was built by the order of Queen Artemisia in memory of her husband Mausolus, Prince of Caria—hence its name, the Mausoleum—and it was

called by the ancients one of the seven wonders of the world.

The Mausoleum was a pillared building with friezes and a pyramid-like summit surmounted by a marble *quadriga,* or four-horse chariot. The work on it was divided among the sculptors. Pythius, the architect, was responsible for the wonderful chariot and horses that crowned it, and Scopas chiseled the frieze on the east side.

The Mausoleum was almost entirely destroyed in 1402 by the Knights of St. John, who, we remember, were members of an order instituted in Crusading times in order to help the pilgrims to Jerusalem. When, later, they became a military power and were at war with the Turks, they captured Halicarnassus, and in the course of their fighting they ruined the lovely Mausoleum. On its site they built their castle of St. Peter, called by the Turks Budrun. Many statues of marble were sacrificed to make lime. Vandals exploring in later years destroyed still more. About the middle of the nineteenth century some portions of the frieze were brought to England, and presently the site was fully excavated.

ONE OF THE EARLIEST PORTRAITS IN GREEK SCULPTURE

Crowning the building was a colossal group of Mausolus and his queen standing in the chariot, and these figures, now in the British Museum, give us some idea of the fineness of the work. The statue of the prince is particularly interesting in that it is a definite portrait, one of the earliest in Greek sculpture.

The large Mausoleum frieze in the British Museum tells of the war with the Amazons—the tale that sculptors were so fond of portraying. A most wonderful fragment is the figure of the charioteer from the small frieze.

The treatment of the drapery in these groups is of historic interest. It shows the advance from the severe folds of classic art, and points to the possibilities of drapery in marble finally accomplished in the peerless Victory of Samothrace. This statue, which stands at the head of the staircase in the Louvre, was sculptured about the end of the fourth century, and shows the influence both of Scopas and of Lysippus. In all the centuries that have followed, no sculpture has been able to rival the marble draperies of the Samothrace Victory.

Lysippus was a native of Sicyon, a town in the Peloponnesus, and he made Sicyon art famous, just as Polyclitus brought renown to the Argive school. He produced a very great number of statues, but as he worked entirely in bronze, they have all disappeared. Lysippus was essentially a sculptor of striking or athletic types. He used to say that his masters were the Canon of Polyclitus and Nature, but he really departed from the proportions of the Canon and made a new scheme of proportions. To the work of the fourth century, so largely Attic in its best, Lysippus brought a strong strain of the Doric school. He was employed by Alexander the Great in many commissions, and produced a great variety of works—portraits of the emperor, hunting and fighting scenes, statues of athletes, and the usual representation of deities.

LYSIPPUS AND THE MONEY-BOX THAT WAS BROKEN OPEN AT HIS DEATH

There is a happy story told of Lysippus that he put a coin for every commission he held into a vase which had no opening save the narrow one through which he dropped the coins. On his death it was broken, and fifteen hundred coins came out. Had he worked in marble something might have been left out of the wreck of time. As it is, we are thankful to have some marble copies of his bronzes.

The well-known Venus of Medici, now in the Uffizi in Florence, may be a marble copy of his bronze statue. In the Dresden Museum is a fine draped figure found at Herculaneum, again a marble copy. But the statue by which Lysippus is most remembered is the famous athlete, the Apoxyomenus, in which can be seen his variation from the Doryphorus of Polyclitus, known as the Canon. The athletic type introduced by Lysippus was lighter, taller, than that of the Canon, as the marble copy of the Apoxyomenus in the Vatican shows, and this innovation had a marked effect on the sculpture of the day.

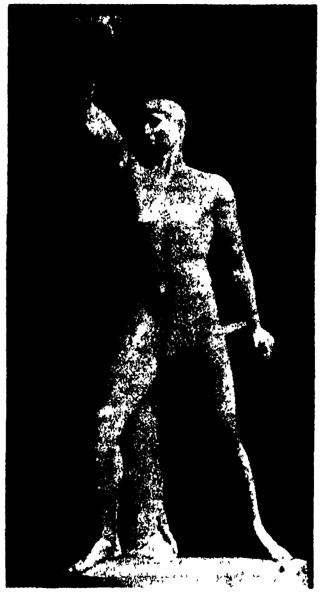
Lysippus is a strange figure in Greek art. He stands on the threshold of the new world which Alexander made, and still has kinship with the great who had gone before. He was at heart a fine, serious athletic sculptor, with many whims and perversities running through his character like veins in granite.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 4459.

GREAT SCULPTURES OF OLD GREECE

THE MATCHLESS VENUS OF MILO, IN THE LOUVRE, PROBABLY BY A PUPIL OF PHIDIAS

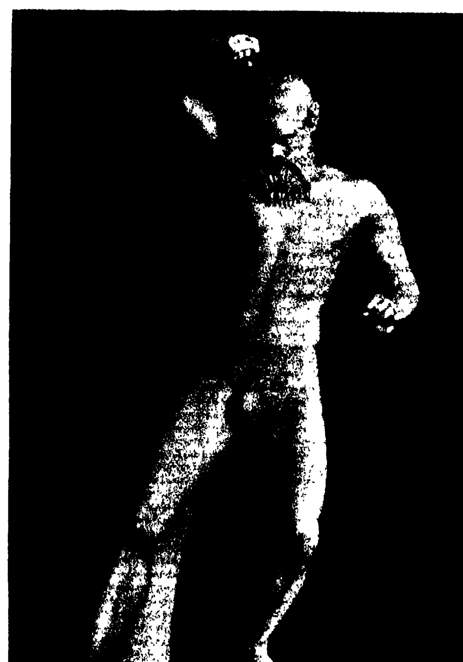
DORYPHORUS, THE SPEAR-BEARER, AFTER POLYCLITUS



HARMODIUS, A HERO OF ATHENS

DIADUMENUS, THE VICTORIOUS ATHLETE, AFTER POLYCLITUS

A FINE FIGURE OF AN AMAZON, AFTER POLYCLITUS



MARSYAS, SOMETIMES CALLED THE DANCING FAUN, AFTER MYRON

A COPY OF THE STATUE OF A YOUNG FAUN BY PRAXITELES

A MARBLE COPY OF APOXYOMENUS BY LYSIPPUS, IN THE VATICAN

THE MARBLE STATUE OF HERMES, BY PRAXITELES, FOUND AT OLYMPIA

AN EARLY COPY OF A STATUE OF HERMES BY THE SCHOOL OF PRAXITELES


A HEAD OF HERACLES IN THE STYLE OF SCOPAS


A BRONZE HEAD OF VENUS FOUND IN ASIA MINOR


A BRONZE STATUE OF A YOUNG ATHENIAN


THE VICTORY OF SAMOTHRACE, IN THE LOUVRE


NIOBE SHIELDING HER YOUNGEST DAUGHTER


HYPNOS, OR SLEEP, A STATUE IN THE STYLE OF PRAXITELES


A BEAUTIFUL STONE ABOVE AN ATHENIAN TOMB


THE BORGHESE WARRIOR, IN THE LOUVRE

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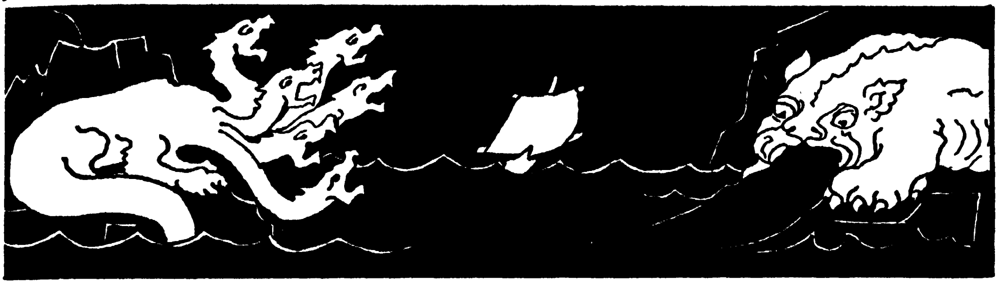


Scylla, the many-headed monster, and the terrible Charybdis lie in wait for the boat of Odysseus.

HOMER'S ODYSSEY

HOMER'S first poem, the ILIAD, is a story of war, in which the Greek armies conquer Troy. It is filled with battles and the great deeds of the heroes on both sides. Homer's second poem is the ODYSSEY, the story of one leader's return from that war. The leader's name is Odysseus, whom the Romans called Ulysses. We tell you about the ILIAD on page 3076. Here we shall speak of the ODYSSEY.

Odysseus, in the story, was king of an island, Ithaca. This is a real island on the west coast of Greece: you will find it on the map. Look also at Asia Minor. On the coast, up near the Dardanelles, was Troy, or Ilium, as the Greeks called it. That name gave the title to Homer's first poem, the ILIAD. In the first part of the ILIAD we meet Odysseus. He is described as very wise and clever, and shows himself a great athlete in the games which were held by Achilles. It was Odysseus who suggested that the Greeks build a hollow wooden horse, hide men inside and by a trick get it into the city of Troy. By this trick the Greeks won the war.

Instead of starting home with the other Greek heroes after Troy had fallen, Odysseus sailed north and raided a city of the Ciconians, to get supplies for himself and his men. Some of his followers were lost in this adventure, before Odysseus and the rest set sail for Ithaca. A great storm arose, however, and they were carried down to the coast of Africa. Here was the land of the lotus-eaters. Some of Odysseus' men ate of the lotus plant, which caused them to forget their homes and families. Odysseus ordered these men brought to the ship by force, and quickly sailed away.

The expedition sailed until they came to the land of the Cyclopses, a strange race of one-eyed monsters. The Greeks beached their ships on a near-by island. In the morning Odysseus ordered his sailors to wait while he went to learn what kind of people these Cyclopses were. He went ashore with twelve trusty men. They came to a cave filled with lambs, kids and cheeses. The men wished to carry away to the ships what provisions they could, but Odysseus commanded them to wait until the owner of the cave should return.

At sundown the Cyclops .Polyphemus came, a huge giant with his one great eye in the middle of his forehead. He was a shepherd and he drove his flock before him into the cave. Then he lifted a huge stone and set it in the opening. Odysseus and his men hid in a corner of the cave, but when the giant had kindled his fire, he discovered them. Odysseus came forward and told the giant that he and the others were Greeks who had been storm-driven across the seas.

The monster laughed, and seizing two of the men, he dashed out their brains and devoured their flesh for his supper. At last the giant slept, while Odysseus planned a way to escape. It would do no good to kill the giant because the men could not lift the stone which blocked the opening to the cave. In the morning the giant ate two more men and drove his flocks from the cave, but he did not forget to block the opening with the great stone. Odysseus and the eight remaining men were imprisoned in the dark cave all day.

That evening, after the giant had devoured two more men, Odysseus gave him much strong wine. When the Cyclops had fallen into a deep sleep, the men blinded him with

Here is Polyphemus, the one-eyed Cyclops. He killed and ate some of Odysseus' men, who hid in his cave.

a red hot stake and hid from him during the night. In the morning the blinded giant let his flocks go through the open doorway but stood there groping with his hands so that the men might not escape. But Odysseus had bound the sheep together in threes, and under the middle sheep of each group one of his men clung. Odysseus himself clung to a large ram, and they passed safely from the cave. In the doorway of his cave the Cyclops called upon his father, the sea-god Poseidon, to punish Odysseus, and his call was answered, as you shall hear.

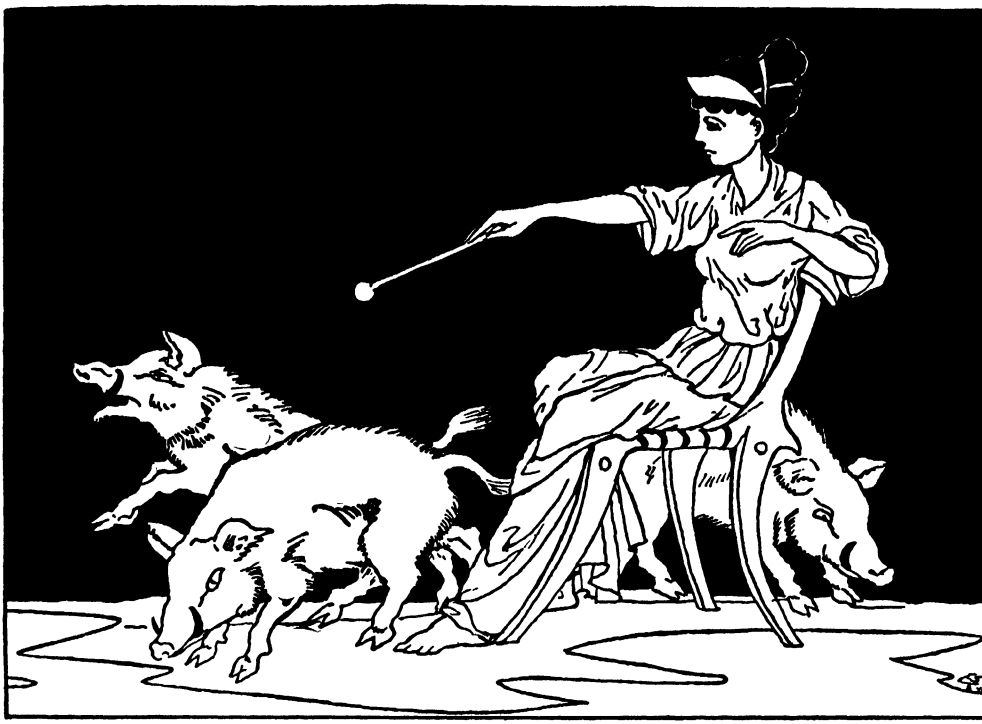
WHAT HAPPENED WHEN ODYSSEUS' MEN OPENED THE BAG OF WINDS

The Greeks, sailed on to the island where dwelt Aeolus, the keeper of the winds. Aeolus, welcomed the travelers kindly. When they left he tied all the contrary winds in a leather bag and gave them to Odysseus, and the god called the west wind to blow the ships safely back to Ithaca. For nine days and nights Odysseus guided his vessel and watched the bag of winds; but on the tenth, when the very fields of Ithaca were in sight, he slept. Then the men, thinking the bag held treasure of great value, opened the bag, and the unruly winds burst forth. The storm which followed blew the ships back across the sea to Aeolia. This time Aeolus refused to help them, and sadly they set sail again on the long voyage toward home.

After six days they came to the harbor of Lamos, where the fierce Laestrygonians lived. All the ships except the black ship of Odysseus sailed into the harbor, but Odysseus anchored his vessel outside. When the Laestrygonians discovered the Greeks, they wrecked the ships and killed the men. Only Odysseus and the men on board the black ship outside the harbor escaped.

HOW CIRCE TURNED ODYSSEUS' MEN INTO PIGS, AND HOW THEY ESCAPED

Mourning the fate of their comrades, the remaining Greeks sailed on until they reached the island of the sorceress, Circe. The enchantress lured the sailors into her garden, all save one, and by her magic arts she changed them all to pigs and penned them in sties. When Eurylochus, the only sailor who escaped, returned and told Odysseus what had happened, the leader went to Circe to rescue his men. Hermes (Mercury), the Helper, gave him a magic drug that made him immune to Circe's arts. When Circe realized that Odysseus was aided by the gods, she released his men from the evil spell. Then she advised Odysseus about his



Circe was an evil enchantress, who lured men to her garden and then changed them into pigs. Some of Odysseus' followers suffered this fate, but Odysseus was aided by the god Hermes, and forced Circe to change them back into men.

homeward journey and told him how to overcome the dangers he would meet.

The first danger the ship had to pass was the island of the Sirens, where beautiful nymphs sang so sweetly that men tried to reach them, and, sailing too close, wrecked their ships on the rocky coast. Before approaching this danger, Odysseus blocked the ears of his men with wax so that they could not hear. Then he ordered the men to tie him to the mast. As the ship passed the island, the Sirens sang so sweetly that Odysseus begged his men to free him, but they only bound him more tightly, and rowed past as fast as they could.

Soon after they passed this island another danger faced them. Their route was through a narrow passage guarded by two horrors. On one side Scylla, a six-headed monster, sat in the rocks waiting to seize men from passing ships. On the other side Charybdis sucked down the sea, and a ship caught there would be pulled down into her mouth. As they passed Scylla she seized six men from Odysseus' ship; but they passed Charybdis in safety.

They sailed on to the Island of the Sun. Here some of Odysseus' men killed the sacred cattle for food, which so angered the sungod that he refused to shine again unless these men were punished. After they had set sail, therefore, Zeus sent a great storm, which tore the ship apart, and all but Odysseus were drowned. For nine days he drifted on the wreckage, until he came to the island of Ogyia. Here the goddess Calypso rescued him and here she kept him for seven years. She hoped that he would marry her and become an immortal, but Odysseus ever longed for his home in Ithaca, his wife Penelope, and his son Telemachus.

Meanwhile, in Ithaca, Penelope longed for her lost husband and wished for his return. Since most people thought that Odysseus had been lost at sea, the princes of Ithaca and many near-by isles wished Penelope to marry one of them; but Penelope, still hoping that Odysseus would return, refused their proposals. Each day the suitors lounged about the palace, feasting on Odysseus' cattle and drinking his wine. Penelope refused to sit with them and re-

mained in her room with her loyal maids.

When twenty years had passed since the defeat of Troy, the family of Odysseus was in great trouble. Penelope had attempted to deceive the suitors. She told them that when she had finished weaving a certain cloth she would choose a husband. All day she worked at the loom, but at night she ripped out all she had done. For three years she had done this; now one of her maids had betrayed her to the suitors, and Penelope was forced to finish the weaving.

Telemachus was a young man, but the suitors treated him like a child and refused to listen when he told them to return to their homes and stop wasting his property. The goddess Athene appeared to Telemachus and told him to go and see Nestor and Menelaus and learn news of Odysseus. With Athene's help Telemachus and his comrades found a ship and sailed away. When the old nurse told Penelope that Telemachus had gone, Penelope wept bitterly, fearing that her son might never return.

Penelope, the faithful wife of Odysseus.

Athene had always admired Odysseus above all other mortals, and now she prepared to help him safely home. She sent Hermes to Calypso with orders that Odysseus must be helped to leave the island. So, against her will, Calypso helped Odysseus to build a raft and gave him provisions.

As Odysseus sailed across the sea upon his raft, Poseidon spied him, and remembering his blind son, the Cyclops Polyphemus, caused a great storm. The raft was torn apart by the angry seas. Odysseus would have drowned, but the sea-nymph Ino gave him her scarf to bear him over the waters, and Athene guided him to Phaecia.

Here Odysseus was discovered near the shore by the princess Nausicaä. She brought him to her father's court, and there he gave the full story of his adventures and wanderings. The Phaecians were greatly impressed. They gave him many gifts and brought him, on one of their ships, to the shores of Ithaca.

Odysseus hid his gifts and went to the dwelling of his swineherd, Eumaeus. The faithful servant did not recognize his master, for Athene had disguised him as a weak, old beggar. Yet the swineherd was kind to this old man and told him of the wicked suitors who were wasting Odysseus' possessions. Great was the wrath of Odysseus, and he planned a punishment for these princes.

At this time Telemachus returned from his quest and came to the cottage of the swineherd. When he met the beggar, Telemachus was courteous. Then Athene cast off Odysseus' disguise and Telemachus at last found his father. Together, father and son made a plan to punish the suitors.

Telemachus returned to the palace, where Penelope greeted him with tears of joy. In the morning Odysseus went to his palace, still disguised as a beggar. Here the suitors were rude to him, adding fuel to his anger. All day he sat in the hall, learning which of his household were loyal to him. In the evening, still posing as a beggar, he talked to Penelope and told her that Odysseus would soon return; but Penelope could not believe him.

Next day, when the suitors came to the great hall, Odysseus and Telemachus had removed all the armor and all the weapons from the walls. Then Penelope appeared, bearing Odysseus' great bow and quiver of bronze-pointed arrows. She promised that she would marry the man who could shoot the arrows through twelve axes, as Odysseus used to do.

One by one the suitors tried, but none could bend the huge bow. Then Odysseus came forward, still in his lowly disguise. He fitted the arrow to the bow and let it fly—straight through the hole in the bronze ax. While the suitors watched in amazement, Odysseus shot an arrow through each ax. Then, fitting another arrow to the bow, he faced the suitors and told them who he was.

Odysseus killed the most hateful suitors with his arrows; and when Telemachus brought armor and weapons, Odysseus, his son and the swineherd fought against the others. The princes were no match for the angry King and his two supporters, and they were all killed. Odysseus summoned his old nurse and bade her clean the room. When everything was in order he sent for Penelope. Then was the heart of the faithful Queen glad that her beloved husband had returned at last.

If you look at a map of the Mediterranean world, you can trace the course of Odysseus' travels. The raid on the Ciconians took Odysseus up to the end of the Aegean Sea. The storm which followed blew the ship down the Aegean Sea, past Crete, and across the Mediterranean to the coast of Africa. The land of the lotus-eaters was just south of Tunisia. Then the hero sailed across to the land of the Cyclopses on the coast of Italy, just north of the Bay of Naples. Aeolia is a small island off the northern coast of Sicily. The ship then sailed almost to Ithaca before it was blown all the way back to Aeolia. From Aeolia Odysseus sailed along the coast of Italy to Circe's island, which is some distance below the Tiber River.

When Odysseus left Circe's island he sailed down the coast of Italy. The Sirens' islands are three rocky islands near the Bay of Naples. So many ships used to be wrecked along their shores that the legend of the sirens grew up. From there the ship had to go through a narrow passage. On one side was a rock upon which many ships were wrecked if the seas were strong. Around this rock developed the legend of Scylla, the man-eating monster. In this same strait was a whirlpool around which the legend of Charybdis developed. The Island of the Sun was at the southeast tip of Sicily, near Syracuse.

According to the maps of Homeric times, Calypso's island was just south of Sardinia, but there is no island there. An island very like this one described by Homer has been found across the Mediterranean near the coast of Spain. From Calypso's island Odysseus went to Phaecia, the modern island of Corfu in the Ionian Sea. As you can see by the map, the voyage from Corfu to Ithaca is very short, along the west coast of Greece.

When Homer composed his poems, the ILIAD and the ODYSSEY, he took the old legends and stories and songs of his people, and strung them together until they made a story about the gods and heroes of a time that was, to him, "the long, long ago." In the tales of the ancient peoples, such as the Hebrews and the Egyptians, we can find similar stories. The old legends had come down from early times, as parents told them to children, and so on through many hundreds of years. Changes crept in, from time to time, as good story-tellers "embroidered" their tales. But many things in the epics are true, as we have learned through our modern discoveries. There was really a walled city named Troy in Asia Minor, that was destroyed in a great fire.

Many of Homer's descriptions must have been based on the life around him, the life of his own day. Scholars believe this, and consider the Greek culture described in the ILIAD and the ODYSSEY as the Homeric Age, the age of Homer. As you read the two epics, try to remember that you are reading tales of great antiquity dressed up in the trappings of a more advanced day.

As we tell you in the chapter on Greek literature, we know little or nothing about Homer; but probably he was a gifted min-

Poseidon (or Neptune), the god of the sea, sought to destroy Odysseus by raising a storm. Odysseus had blinded the Cyclops, son of Poseidon.

strel who sang his stories, and probably it was a later man who finally wrote them down in the form we have now. They are written in what we call hexameter verse, that is, with the rhythm of six beats to a line. Perhaps you know this form in Longfellow's EVANGELINE—"This is the forest primeval, the murmuring pines and the hemlocks."

There are many things which make Homer's poetry wonderful. Like the ILIAD, the ODYSSEY contains many fine scenes. There are descriptions of ocean storms, of a mariner's life and of home life among the Greeks, of Odysseus' meeting the spirit of his mother, and finally of his dramatic return and the liberation of his home. Homer is skillful in giving fine comparisons, and many of his words are pictures in themselves, such as the "wine-dark sea," the "bright" and "honey-hearted" wine, the "golden-throned" and "rosy-fingered" dawn. The English poet, Andrew Lang, wrote, "Homer, thy song men liken to the sea," and speaks of "The surge and thunder of the ODYSSEY."

WOMEN PLAY AN IMPORTANT PART IN THE STORY OF THE ODYSSEY

While the ILIAD told mainly of men and battles, the ODYSSEY has many scenes of home life and of women. Foremost among the women is the goddess, "grey-eyed" Athene, friend of Odysseus, divine and very human. Like the other gods and goddesses, Athene is fond of intervening in the fortunes of the mortals she loves, and this, of course, makes their lives more complicated and exciting. Among mortal women the devoted wife, Penelope, is one of the chief figures of the ODYSSEY. She has become a symbol of patient loyalty. The devoted love which she shows to her son and husband appears in many scenes, and especially when Odysseus in disguise converses with her. She represents an ideal as wife and mother and as keeper of the household.

Close to Penelope in affectionate loyalty is the old nurse, Eurycleia. She stands by her mistress on all occasions, but keeps her promise to Telemachus that his mother shall not know he has gone off to seek word of his father. The nurse recognizes Odysseus through his disguise; but she keeps his identity hidden until he tells her to reveal it.

A lovely girl in the ODYSSEY is the young princess, Nausicaä, who welcomes Odysseus in his travels and brings him to her father's court. She is a bright, appealing lassie, whether busily washing clothes for her wedding day, or playing ball with her maidens beside the river while the snowy linens are drying.

Calypso is described by Odysseus as "an awful goddess, nor is any, either of gods or mortals, conversant with her." Completely evil are Circe and the Sirens, who seek only to lure men to destruction. Yet Circe, once defeated by Odysseus, gives him useful information for proceeding on his journey.

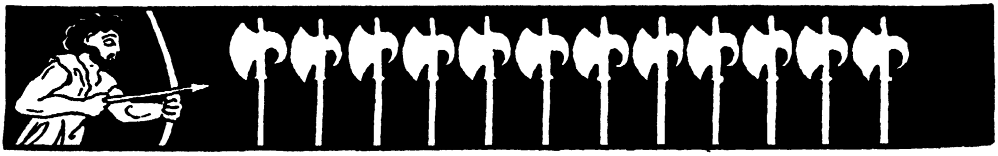
LOVE OF HOME AND COUNTRY IN THIS GREAT ADVENTURE POEM

Odysseus tells us of his homeland, "clear-seen Ithaca . . . a rugged isle, but a good nurse of noble youths." And he adds, "Surely there is nothing sweeter than a man's own country and his parents, even though he dwell far off in a rich house, in a strange land." It was the love of home and country that carried Odysseus through his great adventures. Homer is ranked with Dante and Shakespeare as one of the three greatest poets of all literature. His ODYSSEY is as fresh and beautiful today as when he wrote it, almost three thousand years ago.

If you knew Greek well you could read the ODYSSEY in its original form. But we have some fine translations of it in English. The American poet, William Cullen Bryant, has translated it beautifully in verse. Other famous translations are the older one in verse by the English poet, Alexander Pope; the prose version by S. H. Butcher and A. Lang; and another by G. H. Palmer. An excellent translation, in hexameter verse, like the original Greek, is the one by the Englishman, H. B. Cotterill. We give you two beautiful poems by Alfred, Lord Tennyson about the ODYSSEY. On page 4275 you will find THE LOTUS-EATERS, and on page 4269 is ULYSSES (which is the Latin form of Odysseus' name).

By FLORENCE V. GEEHR and HUGH H. BLAKE.

THE NEXT STORY OF FAMOUS BOOKS IS ON PAGE 4644.



LOVE AND FRIENDSHIP

Illustrated by Marie Lawson

Believe Me, If All Those Endearing Young Charms

By THOMAS MOORE (1779–1852)

BELIEVE me, if all those endearing young charms,
Which I gaze on so fondly today,
Were to change by tomorrow, and fleet in my arms,
Like fairy-gifts fading away,
Thou wouldst still be adored, as this moment thou art,
Let thy loveliness fade as it will,
And around the dear ruin each wish of my heart
Would entwine itself verdantly still.

It is not while beauty and youth are thine own,
And thy cheeks unprofaned by a tear,
That the fervor and faith of a soul may be known,
To which time will but make thee more dear!
No, the heart that has truly loved never forgets,
But as truly loves on to the close,
As the sunflower turns to her god when he sets
The same look which she turned when he rose!

Douglas, Douglas, Tender and True

By DINAH MARIA MULOCK CRAIK (1826–1887)

COULD ye come back to me, Douglas, Douglas,
In the old likeness that I knew,
I would be so faithful, so loving, Douglas,
Douglas, Douglas, tender and true.

Never a scornful word should grieve ye,
I'd smile on ye sweet as the angels do;—
Sweet as your smile on me shone ever,
Douglas, Douglas, tender and true.

O to call back the days that are not!
My eyes were blinded, your words were few;
Do you know the truth now up in heaven,
Douglas, Douglas, tender and true?

I was never worthy of you, Douglas,
Not half worthy the like of you;
Now all men seem to me like shadows—
Douglas, Douglas, tender and true.

Stretch out your hand to me, Douglas, Douglas,
Drop forgiveness from heaven like dew,
As I lay my heart on your dead heart, Douglas,
Douglas, Douglas, tender and true.

How Do I Love Thee?

From SONNETS FROM THE PORTUGUESE

By ELIZABETH BARRETT BROWNING (1806–1861)

HOW do I love thee? Let me count the ways.
I love thee to the depth and breadth and height
My soul can reach, when feeling out of sight
For the ends of Being and ideal Grace.
I love thee to the level of everyday's
Most quiet need, by sun and candle-light.
I love thee freely, as men strive for Right;
I love thee purely, as they turn from Praise.
I love thee with the passion put to use
In my old griefs, and with my childhood's faith.
I love thee with a love I seemed to lose
With my lost saints,—I love thee with the breath,
Smiles, tears, of all my life!—and, if God choose,
I shall but love thee better after death.

The Blessed Damozel

By DANTE GABRIEL ROSSETTI (1828–1882)

THE blessed damozel leaned out
From the gold bar of Heaven;
Her eyes were deeper than the depth
Of waters stilled at even;
She had three lilies in her hand,
And the stars in her hair were seven.

Her robe, ungirt from clasp to hem,
No wrought flowers did adorn,
But a white rose of Mary's gift,
For service sweetly worn;
Her hair that lay along her back
Was yellow like ripe corn.

Herseemed she scarce had been a day
One of God's choristers;
The wonder was not yet quite gone
From that still look of hers;
Albeit, to them she left, her day
Had counted as ten years.

(To one, it is ten years of years.
. . . Yet now, and in this place,
Surely she leaned o'er me—her hair
Fell all about my face. . . .
Nothing: the autumn fall of leaves.
The whole year sets apace.)

It was the rampart of God's house
That she was standing on;
By God built over the sheer depth
The which is Space begun;
So high, that looking downward thence
She scarce could see the sun.

It lies in Heaven, across the flood
Of ether, as a bridge.
Beneath, the tide of day and night
With flame and darkness ridge
The void, as low as where this earth
Spins like a fretful midge.

Around her, lovers, newly met
'Mid deathless love's acclaims,
Spoke evermore among themselves
Their heart-remembered names;
And the souls mounting up to God
Went by her like thin flames.

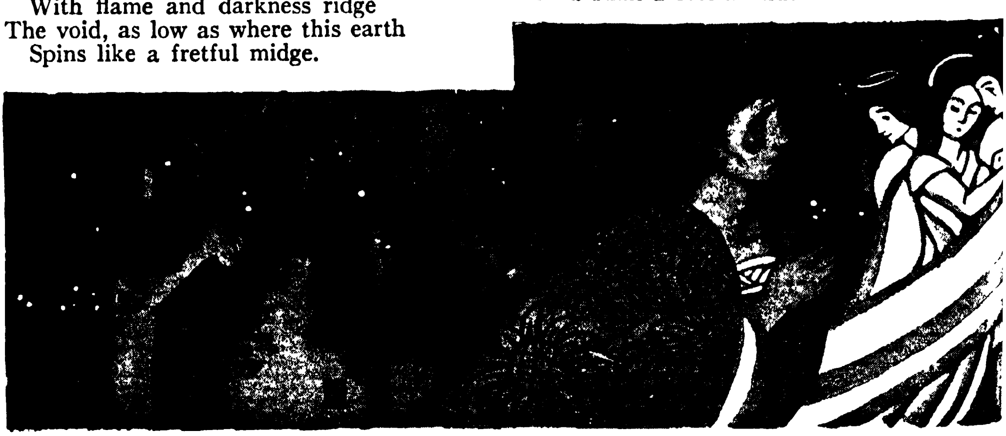
And still she bowed herself and stooped
Out of the circling charm;
Until her bosom must have made
The bar she leaned on warm,
And the lilies lay as if asleep
Along her bended arm.

From the fixed place of Heaven she saw
Time like a pulse shake fierce
Through all the worlds. Her gaze still strove
Within the gulf to pierce
Its path; and now she spoke as when
The stars sang in their spheres.

The sun was gone now; the curled moon
Was like a little feather
Fluttering far down the gulf; and now
She spoke through the still weather.
Her voice was like the voice the stars
Had when they sang together.

(Ah sweet! Even now, in that bird's song,
Strove not her accents there,
Fain to be hearkened? When those bells
Possessed the mid-day air,
Strove not her steps to reach my side
Down all the echoing stair?)

"I wish that he were come to me,
For he will come," she said.
"Have not I prayed in Heaven?—on earth,
Lord, Lord, has he not prayed?
Are not two prayers a perfect strength?
And shall I feel afraid?



"When round his head the aureole clings,
  And he is clothed in white,
I'll take his hand and go with him
  To the deep wells of light;
As unto a stream we will step down,
  And bathe there in God's sight.

"We two will stand beside that shrine,
  Occult, withheld, untrod,
Whose lamps are stirred continually
  With prayer sent up to God;
And see our old prayers, granted, melt
  Each like a little cloud.

"We two will lie i' the shadow of
  That living mystic tree
Within whose secret growth the Dove
  Is sometimes felt to be,
While every leaf that His plumes touch
  Saith His name audibly.

"And I myself will teach to him,
  I myself, lying so,
The songs I sing here; which his voice
  Shall pause in, hushed and slow,
And find some knowledge at each pause,
  Or some new thing to know."

(Alas! we two, we two, thou say'st!
  Yea, one wast thou with me
That once of old. But shall God lift
  To endless unity
The soul whose likeness with thy soul
  Was but its love for thee?)

"We two," she said, "will seek the groves
  Where the lady Mary is,
With her five handmaidens, whose names
  Are five sweet symphonies,
Cecily, Gertrude, Magdalen,
  Margaret and Rosalys.

"Circlewise sit they, with bound locks
  And foreheads garlanded;
Into the fine cloth white like flame
  Weaving the golden thread,
To fashion the birth-robes for them
  Who are just born, being dead.

"He shall fear, haply, and be dumb:
  Then will I lay my cheek
To his, and tell about our love,
  Not once abashed or weak:
And the dear Mother will approve
  My pride and let me speak.

"Herself shall bring us, hand in hand,
  To Him round whom all souls
Kneel, the clear-ranged unnumbered heads
  Bowed with their aureoles:
And angels meeting us shall sing
  To their citherns and citoles.

"There will I ask of Christ the Lord
  Thus much for him and me:—
Only to live as once on earth
  With Love, only to be,
As then awhile, for ever now
  Together, I and he."

She gazed and listened and then said,
  Less sad of speech than mild,—
"All this is when he comes." She ceased.
  The light thrilled towards her, filled
With angels in strong level flight.
  Her eyes prayed, and she smiled.

(I saw her smile.) But soon their path
  Was vague in distant spheres:
And then she cast her arms along
  The golden barriers,
And laid her face between her hands,
  And wept. (I heard her tears.)

Annabel Lee

By Edgar Allan Poe (1809–1849)

It was many and many a year ago,
In a kingdom by the sea,
That a maiden there lived whom you may know
By the name of Annabel Lee;
And this maiden she lived with no other thought
Than to love and be loved by me.

I was a child and she was a child,
In this kingdom by the sea,
But we loved with a love that was more than love,
I and my Annabel Lee;
With a love that the wingèd seraphs of heaven
Coveted her and me.

And this was the reason that, long ago,
In this kingdom by the sea,
A wind blew out of a cloud, chilling
My beautiful Annabel Lee;
So that her highborn kinsman came
And bore her away from me,
To shut her up in a sepulcher
In this kingdom by the sea.

The angels, not half so happy in heaven,
Went envying her and me;
Yes! that was the reason (as all men know,
In this kingdom by the sea)
That the wind came out of the cloud by night,
Chilling and killing my Annabel Lee:

But our love it was stronger by far than the love
Of those who were older than we,
Of many far wiser than we;
And neither the angels in heaven above,
Nor the demons down under the sea,
Can ever dissever my soul from the soul
Of the beautiful Annabel Lee:

For the moon never beams, without bringing me dreams
Of the beautiful Annabel Lee;
And the stars never rise, but I feel the bright eyes
Of the beautiful Annabel Lee;
And so, all the night-tide, I lie down by the side
Of my darling—my darling—my life and my bride,
In the sepulcher there by the sea,
In her tomb by the sounding sea.

Serenade

From THE SPANISH STUDENT

By HENRY W. LONGFELLOW (1807–1882)

STARS of the summer night!
  Far in yon azure deeps,
Hide, hide your golden light!
  She sleeps!
My lady sleeps!
  Sleeps!

Moon of the summer night!
  Far down yon western steeps,
Sink, sink in silver light!
  She sleeps!
My lady sleeps!
  Sleeps!

Wind of the summer night!
  Where yonder woodbine creeps,
Fold, fold thy pinions light!
  She sleeps!
My lady sleeps!
  Sleeps!

Dreams of the summer night!
  Tell her, her lover keeps
Watch! while in slumbers light
  She sleeps!
My lady sleeps!
  Sleeps!

Earl Mertoun's Song

From THE BLOT IN THE 'SCUTCHEON

By ROBERT BROWNING (1812–1889)

THERE's a woman like a dewdrop, she's so
  purer than the purest;
And her noble heart's the noblest, yes, and
  her sure faith's the surest:
And her eyes are dark and humid, like the
  depth on depth of luster
Hid i' the harebell, while her tresses, sunnier
  than the wild-grape cluster,
Gush in golden-tinted plenty down her neck's
  rose-misted marble:
Then her voice's music . . . call it the well's
  bubbling, the bird's warble!

And this woman says, "My days were sunless
  and my nights were moonless,
Parched the pleasant April herbage, and the
  lark's heart's outbreak tuneless,
If you loved me not!" And I who (ah, for
  words of flame!) adore her,
Who am mad to lay my spirit prostrate
  palpably before her—
I may enter at her portal soon, as now her
  lattice takes me,
And by noontide as by midnight make her
  mine, as hers she makes me!

The Shepherdess*

By ALICE MEYNELL (1853–1922)

SHE walks—the lady of my delight—
  A shepherdess of sheep.
Her flocks are thoughts. She keeps
  them white;
  She guards them from the steep.
She feeds them on the fragrant height,
  And folds them in for sleep.

She roams maternal hills and bright,
  Dark valleys safe and deep.
Into that tender breast at night
  The chastest stars may peep.
She walks—the lady of my delight—
  A shepherdess of sheep.

She holds her little thoughts in sight,
  Though gay they run and leap.
She is so circumspect and right;
  She has her soul to keep.
She walks—the lady of my delight—
  A shepherdess of sheep.

The Passionate Shepherd to His Love

By Christopher Marlowe (1564–1593)

Come live with me and be my Love,
  And we will all the pleasures prove
That hills and valleys, dales and fields,
Or woods or steepy mountain yields.

And we will sit upon the rocks,
And see the shepherds feed their flocks
By shallow rivers, to whose falls
Melodious birds sing madrigals.

And I will make thee beds of roses
And a thousand fragrant posies;
A cap of flowers, and a kirtle
Embroidered all with leaves of myrtle.

A gown made of the finest wool
Which from our pretty lambs we pull;
Fair-linèd slippers for the cold,
With buckles of the purest gold.

A belt of straw and ivy-buds
With coral clasps and amber studs;
And if these pleasures may thee move,
Come live with me and be my Love.

The shepherd swains shall dance and sing
For thy delight each May morning:
If these delights thy mind may move,
Then live with me and be my Love.

The Nymph's Reply to the Passionate Shepherd

By Sir Walter Raleigh
(1552–1618)

If all the world and love were young,
  And truth in every shepherd's tongue,
These pretty pleasures might me move
To live with thee, and be thy Love.

But Time drives flocks from field to fold;
When rivers rage and rocks grow cold;
And Philomel becometh dumb;
The rest complain of cares to come.

The flowers do fade, and wanton fields
To wayward Winter reckoning yields:
A honey tongue, a heart of gall,
Is fancy's spring, but sorrow's fall.

Thy gowns, thy shoes, thy beds of roses,
Thy cap, thy kirtle, and thy posies,
Soon break, soon wither,—soon forgotten,
In folly ripe, in reason rotten.

Thy belt of straw and ivy-buds,
Thy coral clasps and amber studs,—
All these in me no means can move
To come to thee and be thy Love.

But could youth last, and love still breed,
Had joys no date, nor age no need,
Then these delights my mind might move
To live with thee and be thy Love.

To Celia

By Ben Jonson (1573–1637)

Drink to me only with thine eyes,
  And I will pledge with mine;
Or leave a kiss but in the cup
  And I'll not look for wine.
The thirst that from the soul doth rise
  Doth ask a drink divine;
But might I of Jove's nectar sup,
  I would not change for thine.

I sent thee late a rosy wreath,
  Not so much honoring thee
As giving it a hope that there
  It could not withered be;
But thou thereon didst only breathe,
  And sent'st it back to me;
Since when it grows, and smells,
    I swear,
  Not of itself but thee!

Sally In Our Alley

By HENRY CAREY (d. 1743)

OF all the girls that are so smart
 There's none like pretty Sally;
She is the darling of my heart,
 And she lives in our alley.
There is no lady in the land
 Is half so sweet as Sally;
She is the darling of my heart,
 And she lives in our alley.

Her father he makes cabbage-nets,
 And through the streets does cry 'em;
Her mother she sells laces long
 To such as please to buy 'em;
But sure such folks could ne'er beget
 So sweet a girl as Sally!
She is the darling of my heart,
 And she lives in our alley.

When she is by, I leave my work,
 I love her so sincerely;
My master comes like any Turk,
 And bangs me most severely:
But let him bang his bellyful,
 I'll bear it all for Sally;
She is the darling of my heart,
 And she lives in our alley.

Of all the days that's in the week
 I dearly love but one day—
And that's the day that comes betwixt
 A Saturday and Monday;
For then I'm dressed all in my best
 To walk abroad with Sally;
She is the darling of my heart,
 And she lives in our alley.

My master carries me to church,
 And often I am blamèd
Because I leave him in the lurch
 As soon as text is namèd;
I leave the church in sermon-time
 And slink away to Sally;
She is the darling of my heart,
 And she lives in our alley.

When Christmas comes about again,
 O, then I shall have money;
I'll hoard it up, and box it all,
 I'll give it to my honey:
I would it were ten thousand pound,
 I'd give it all to Sally;
She is the darling of my heart,
 And she lives in our alley.

The Look*

By SARA TEASDALE (1884–1933)

STREPHON kissed me in the spring,
 Robin in the fall,
But Colin only looked at me
 And never kissed at all.

Strephon's kiss was lost in jest,
 Robin's lost in play,
But the kiss in Colin's eyes
 Haunts me night and day.

To Helen

By EDGAR ALLAN POE (1809–1849)

HELEN, thy beauty is to me
 Like those Nicaean barks of yore,
That gently, o'er a perfumed sea,
 The weary, wayworn wanderer bore
 To his own native shore.

On desperate seas long wont to roam,
 Thy hyacinth hair, thy classic face,
Thy Naiad airs, have brought me home
 To the glory that was Greece
 And the grandeur that was Rome.

Lo! in yon brilliant window-niche
 How statue-like I see thee stand,
The agate lamp within thy hand!
 Ah, Psyche, from the regions which
 Are Holy Land!

* From Collected Poems of Sara Teasdale, by permission of the publishers, The Macmillan Company.

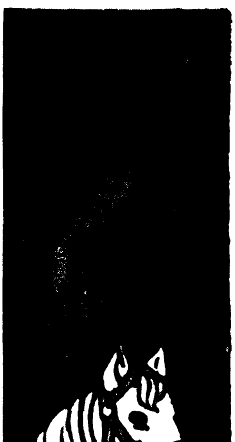
To Lucasta, on Going to the Wars

By RICHARD LOVELACE (1618–1658)

TELL me not, Sweet, I am unkind
That from the nunnery
Of thy chaste breast and quiet mind,
To war and arms I fly.

True, a new mistress now I chase,
The first foe in the field;
And with a stronger faith embrace
A sword, a horse, a shield.

Yet this inconstancy is such
As you too shall adore;
I could not love thee, dear, so much,
Loved I not honor more.

Jenny Kissed Me

By LEIGH HUNT (1784–1859)

JENNY kissed me when we met,
Jumping from the chair she sat in;
Time, you thief, who love to get
Sweets into your list, put that in!
Say I'm weary, say I'm sad,
Say that health and wealth have
missed me,
Say I'm growing old, but add,
Jenny kissed me.

A Red, Red Rose

By ROBERT BURNS
(1759–1796)

O, MY luve's like a red, red rose
That's newly sprung in June;
O, my luve's like the melodie
That's sweetly played in tune.

As fair thou art, my bonnie lass,
So deep in luve am I;
And I will luve thee still, my dear,
Till a' the seas gang dry.

Till a' the seas gang dry, my dear,
And the rocks melt wi' the sun;
I will luve thee still, my dear,
While the sands o' life shall run.

And fare-thee-weel, my only luve!
And fare-thee-weel a while!
And I will come again, my luve,
Though it were ten thousand mile.

John Anderson

By Robert Burns
(1759–1796)

John Anderson my jo, John,
  When we were first acquent
Your locks were like the raven,
Your bonnie brow was brent;
But now your brow is bald, John,
Your locks are like the snow;
But blessings on your frosty pow,
John Anderson my jo.

John Anderson my jo, John,
We clamb the hill thegither,
And mony a canty day, John,
We've had wi' ane anither:
Now we maun totter down, John,
But hand in hand we'll go,
And sleep thegither at the foot,
John Anderson, my jo.

Light

By Francis William Bourdillon
(1852–1921)

The night has a thousand eyes
  And the day but one;
Yet the light of the bright world dies
  With the dying sun.

The mind has a thousand eyes,
  And the heart but one;
Yet the light of a whole life dies
  When love is done.

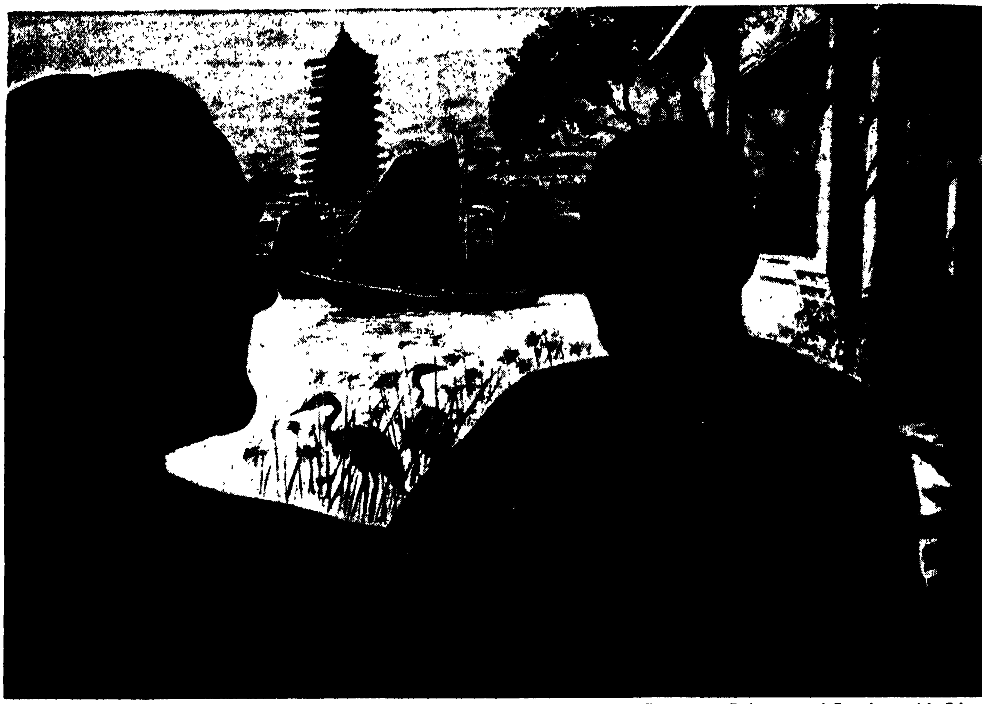
A Birthday

By Christina Rossetti (1830–1894)

My heart is like a singing bird
  Whose nest is in a watered shoot;
My heart is like an apple-tree
  Whose bows are bent with thick-set
    fruit;
My heart is like a rainbow shell
  That paddles in a halcyon sea;
My heart is gladder than all these,
  Because my love is come to me.

Raise me a dais of silk and down;
  Hang it with vair and purple dyes;
Carve it in doves and pomegranates,
  And peacocks with a hundred eyes;
Work it in gold and silver grapes,
  In leaves and silver fleur-de-lys;
Because the birthday of my life
  Is come, my love is come to me.

THE NEXT POEMS ARE ON PAGE 4471.



Courtesy, Chicago and Southern Air Lines

Journeys that formerly took weeks by ship and train may be made in a few hours by airplane.

GEOGRAPHY GROWS WINGS

THE AIRPLANE GIVES A NEW VIEW OF THE EARTH

NOT so long ago, if you wanted to go from your home town to some other city halfway around the world, you would have to travel for a long time.

Probably you would start out by automobile or train. Then you would take an ocean liner. Finally, to finish the trip, you might have to get on a train again. The entire voyage might well take several weeks.

But to-day it is a different story. By long-range plane, you would fly from your local airport to that same city in a few hours.

For the Air Age has come. The world seems to have shrunk because of the plane. The earth on which we live is really smaller than most of us realize. In fact, there is no spot on the globe to-day that is more than sixty hours' flying time from the town in which you live!

To understand how small a world, and what kind of world, we live in to-day, we must study our geography all over again. For the maps we used to study do not always show us a true picture of this world.

From the beginning of history, man has drawn maps to show his idea of what the world was like. On these maps he would put down the land and water areas, the rivers, mountains and towns, and the roadways he knew and used. Captains of ships used the maps to aid them in finding their way from one port to another. Camel caravans used the trade routes to get from one city to another with their silks and spices and other goods. Armies used the maps in times of war.

Until about 450 years ago, most people still believed that the earth was flat. Little by little, as travelers ventured farther from

home, they found new lands, with rivers and towns and mountains, which they added to the edge of their maps.

Then came Columbus. He sailed boldly off the "edge" of the world and discovered that there is no edge. He proved that the world is not really flat, but round. A few years later, Magellan proved it beyond the shadow of a doubt by sailing all the way around the world.

This was exciting news to most people. But it made trouble for the map makers. They found that there was no way to show a true picture of a round world on a flat map. (If you will try skinning an orange and spreading it out flat, you will see why.)

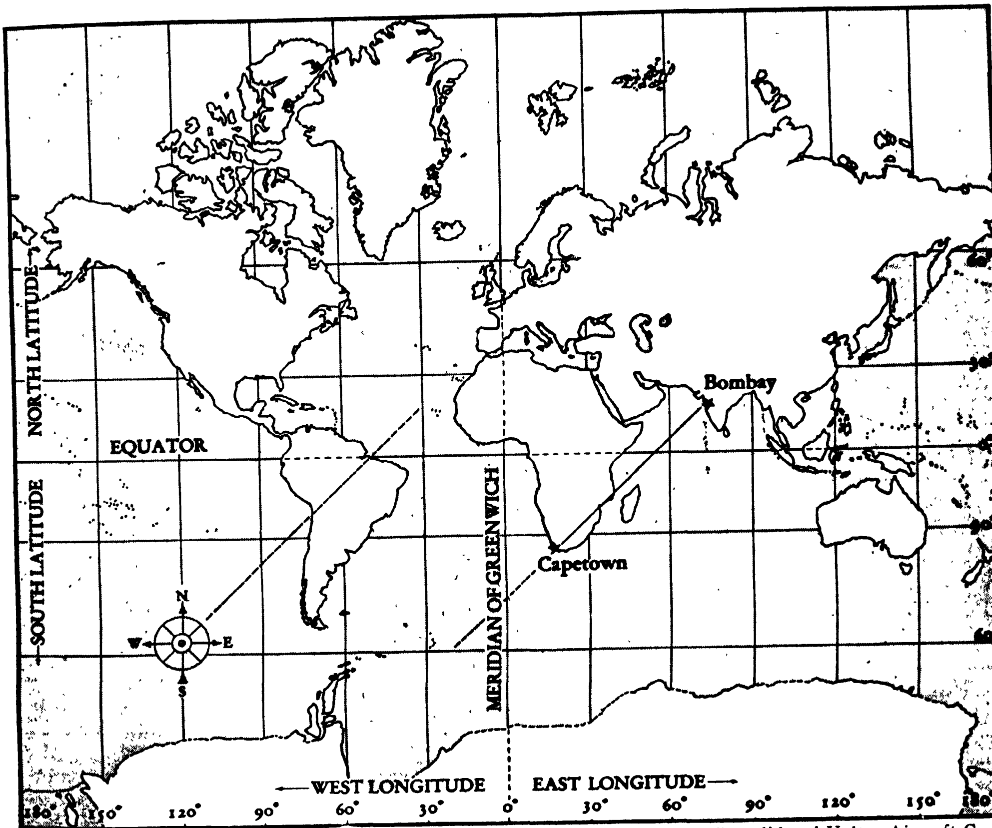
Some of the map-makers tried making globes. These were fine. But people still wanted flat maps which they could spread out on a table and study.

So, one day a map-maker by the name of Mercator had a fine idea. He found a new way to "skin" a globe so that it could be laid down as a flat map of the world.

This map is the one we have come to know best. We call it the Mercator projection, in honor of the man who first made it.

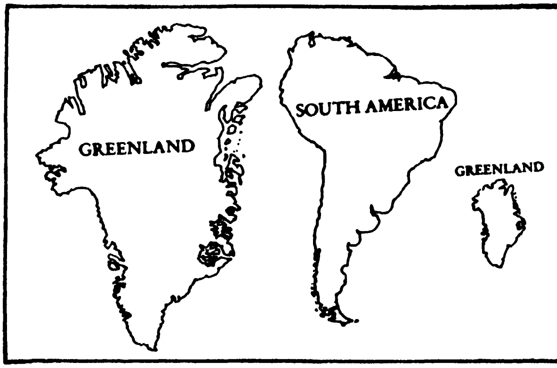
But even this fine map, like any other flat map, is not a true picture of the world. For there is no way to "skin" a globe and lay it down as a flat map without showing some parts of the world out of their true shape or size.

For example, look at South America and Greenland on the Mercator map, above. South America, you see, appears to be smaller than Greenland. You can see this even more clearly when we lift Greenland and South America off the Mercator map and lay them side by side:



Maps, courtesy Richard Edes Harrison and Consolidated Vultee Aircraft Corp.

A Mercator-projection map of the world. Only the regions near the Equator are shown in their correct proportions. The meridians (the vertical lines) would meet at the Poles on a globe; but on this map they are parallel, which means that the land masses appear larger and larger the nearer they are to the Poles.



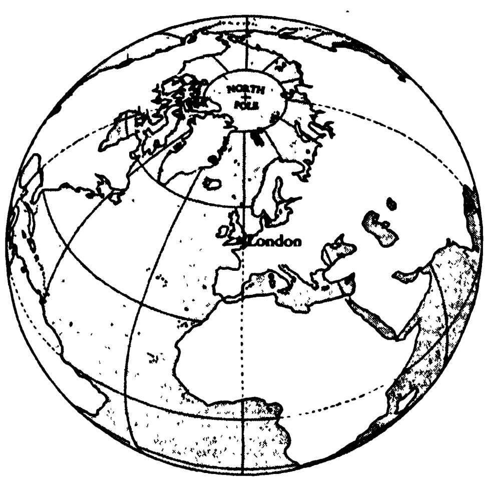
Greenland, at left, as it appears in proportion to South America on Mercator maps; at right, the true relative sizes are shown.

But when we show Greenland in its true size (right), we discover that South America is really about ten times bigger than Greenland!

Thus we learn that even the fine Mercator map does not show us the world as it really is, especially the regions near the Poles. And this brings us to a very important thing to remember when studying geography: since flat maps all have mistakes, when in doubt you must turn to the globe. The globe is not really a map. It is a model of the earth itself. It is the one way to see the true shape and size of all the earth's land and water areas. It is the one true "picture" of the earth.

But even though the globe is fine for studying geography, it, too, has shortcomings. The chief trouble is that on a globe you can see only half of the world at one time.

That is why it is best to study geography on a globe which turns freely in any direction. On such a globe it is easy to choose your own home town, or any city you wish, as the centre of the world. Then you see how the world looks from that point. For example, the globe shown on this page is centred on London. It shows us how an Englishman looks at the world. By turning the globe, you can centre it on your own home town and see how the world about you looks.



As this globe is facing, London is equally distant from every point on the "edge." This is an Air-Age map.

Just as Columbus gave people a new idea of the world when he sailed off the "edge," the long-range airplane is changing our idea of the world.

As air travel becomes more common, we are beginning to think of the world as it really is—not as a flat map but as a globe. And we turn to the globe in geography, because it shows true air distance.

To see why, lay a string tightly over a globe. Put one end of the string on the town in which you live. Put the other end on some distant city, such as Moscow, Russia. This straight line is really a "great circle" route—the shortest air-line distance between your town and Moscow.

But we do not have to depend upon the globe entirely. In addition to the globe, there are also maps which show air-line "great circle" routes as straight lines. The most common form of map which is used for this purpose has rather a long name. It is called an Azimuthal Equidistant projection.

Very often this map is drawn so that its centre is on the North Pole, But it can just as easily be centred on any other spot. On the next page is such a map centred on Washington, D. C. On that map, a straight line drawn from Washington to any other city on the map is a "great circle" air-line route—the shortest distance between Washington and that city, through the air above mountains and oceans.

Some people, when they first see one of these Air Age maps, have said, "Ah! At last we have a perfect map from which to study Air Age geography!" But these people are wrong. They forget that no map is perfect. They forget that all maps, including this one, can give us mistaken ideas of what the world is really like. The mistakes are usually worse round the edge of such a map.

Below is our Azimuthal Equidistant map shown centred on Washington. Can you locate Australia? See how it has s-t-r-e-t-c-h-e-d out, as though it had been squeezed through a clotheswringer!

But even though Australia is such a queer shape, this is a very useful map. For a straight line drawn from Washington to Australia gives us the true "great circle" route—the true and shortest distance between the two.

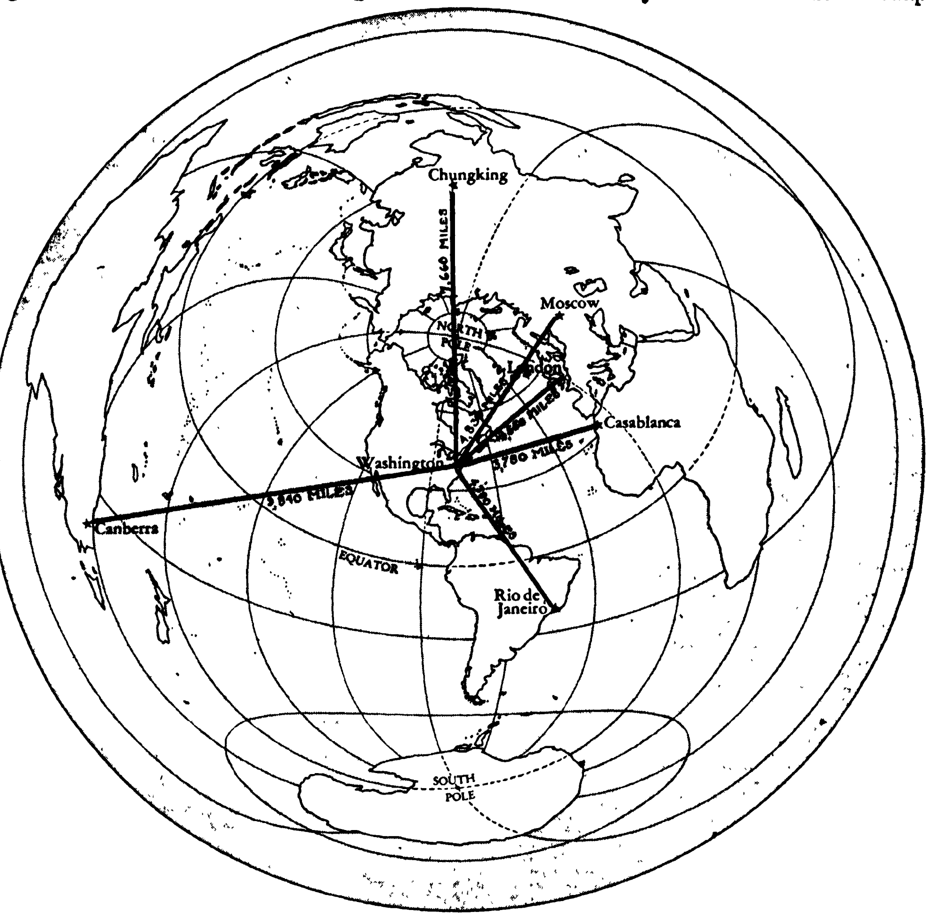
And so, while this map shows some of the world's areas sadly out of shape, it is still a good map for an aviator to use when he is charting a course on which he can measure his flying distance between two points.

It is a good thing, then, to remember this important truth: all flat maps have good features—and all of them have bad features. We must not expect any one map to show us everything we want to find out.

That is why we draw different kinds of maps. Some are good for one purpose, others are best for different purposes.

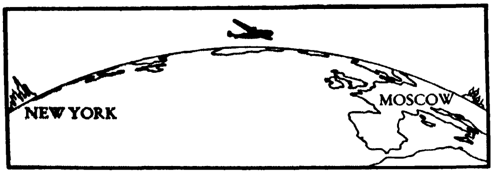
There is not space here to show and talk about the many different kinds of maps; simply remember that if the map you are studying does not show you what you want to know, you can probably find the answer on the globe itself.

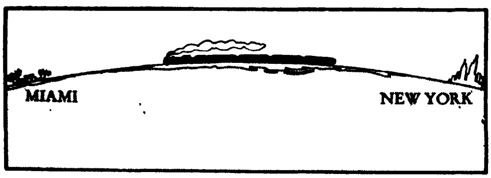
One fact which our new maps show us clearly is this: because of the long-range plane, the nations of the world are now linked closely together. No two countries on earth are more than sixty hours apart by plane. Mountains can not separate the different



An Azimuthal Equidistant map shows some strange facts. The shortest air route between Washington and Chungking, China, lies over the North Pole; the route to Moscow lies north of the British Isles.

members of to-day's Family of Nations, for airplanes fly right over mountains. Oceans can not separate them, either. Even the broad Atlantic and Pacific Oceans are now merely "millponds" which can be flown in a few hours. Distances which used to be measured in thousands of miles and weeks of voyaging, can now be measured in hours of flying time.





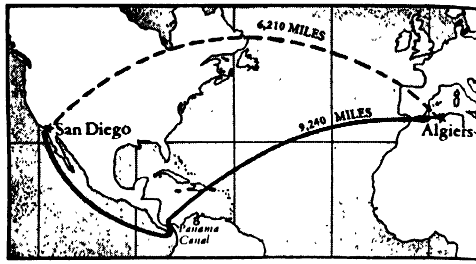
Let us take a few examples, to show why this true:

A long-range express airplane takes off from the New York City airport with passengers for Moscow, Russia. At the same time, a fast express train pulls out of the New York station bound for Miami, Florida. The passengers in the plane will arrive in Moscow before the New York train reaches Miami!

Here is another example which shows how the plane makes the world seem small:

The distance between El Páso, Texas, and San Antonio, Texas, is 617 miles. This is an 18-hour trip by train. The air-line route from New York to London is about 3,460 miles. But you can fly it in 17 hours or less!

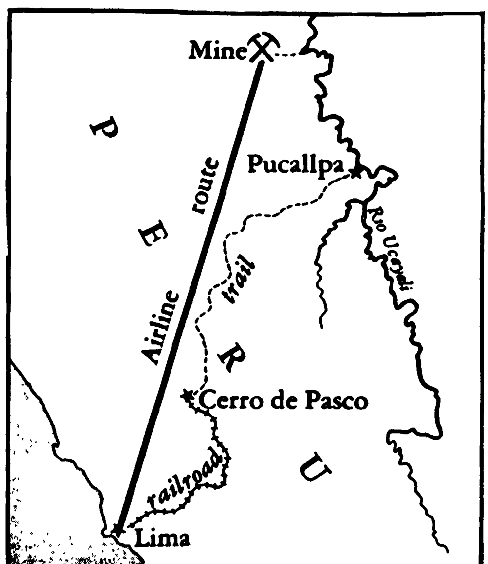
Now let us suppose that a bomber plane built in San Diego, California, were crated and shipped the 9,240 miles to Algiers,



Africa, by sea. It would arrive a month later. But that same plane, flying the 6,210-mile air-line route from San Diego to North Africa, could reach its destination in about 31 hours' flying time!

Or suppose you are the owner of a mine in Peru. You have been having bad luck with your mine. Some very important machinery has broken down. If it is not soon replaced, you will have to close your mine. What can you do about it?

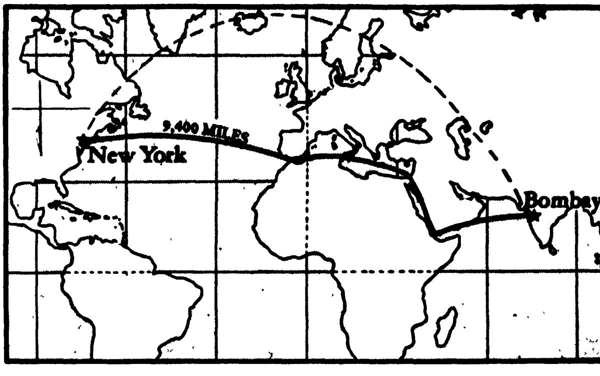
You know that the machinery you need has arrived at Lima, near the coast of Peru. But to get it to your mine by the ordinary way would mean a long delay. The machinery would have to come part of the way on the mountain railroad—a 5-day trip. Then it would be taken apart and loaded on the backs of burros, for a 20-day trip over pack trails. Then it would come the rest of the way by river-boat—another 7 days. You would finally get your machinery 32 days after it



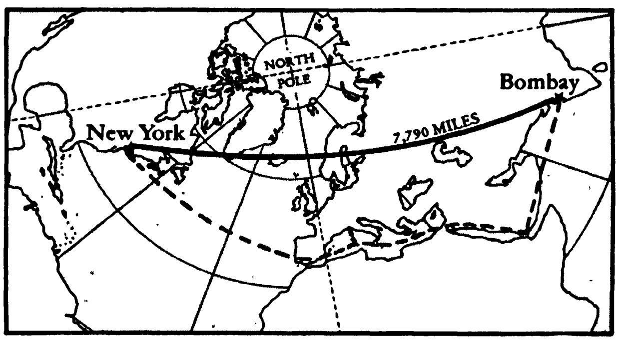
had left the coast, on a long, hard journey.

But if you were to load that machinery into a transport plane at Lima, you would get it in two hours!

A story similar to this can be told about mining machinery needed in the Great Bear Lake region of Canada's Northwest Territories. The pitchblende mines of this area are far from the railroad, in a region of waterways that are frozen solid during part of the year and roads that are sometimes too muddy to use. Without airplanes to carry freight and workers, these rich mines could not have developed so rapidly, nor so well. In fact, Canada has led the world in carrying freight by air over long distances to remote points.



The solid line shows the ocean route between New York and Bombay.



Here the solid line shows the air route, 1,610 miles shorter!

Several years ago a New York business man wished to visit his branch office in Bombay, India. He spent three weeks at sea, voyaging over the 9,400-mile route shown on the Mercator map on this page.

Today this man can board a plane at New York and travel the 7,790-mile air route to Bombay in a little more than a day. His great plane, flying at an altitude of 10,000 feet or more, will speed across the miles so smoothly that most of the time he will scarcely be aware of the motion.

Air travel is still expensive, for the planes are costly to make and to keep in repair. Even so, more and more people are traveling by air each year. One wonderful thing about the Air Age is that, no matter where on this earth we go, we are never very far from home, in terms of time.

People all over the world are interested in air travel; and fliers of all nationalities are being trained. Just as we in Canada and the United States will visit far lands, so shall we have visitors who want to learn about us.

These are exciting days—the beginning of the real Air Age. Look at the timetable below. It shows how long it takes to-day's planes to fly between various world cities.

To-morrow, when there will be even swifter planes, this timetable will seem slow! For the flying time shown above is based on a speed of only 200 miles per hour. It is no secret that right now airplane designers and builders are working on planes that fly so fast they approach the speed of sound itself—741 miles per hour!

When such planes streak across our "great circle" skyways, flying so high that even the earth itself is out of sight, how small indeed the world will become!

AIR-AGE TIMETABLE

FROM	TO	AIRLINE MILES	HOURS
New York	Berlin	3,460	20
Chicago	Singapore	9,365	47
New York	Capetown	7,801	39
San Francisco	Brisbane	7,900	39
Washington	Moscow	4,883	24
London	Rome	887	4½
New York	London	3,960	17
London	Berlin	574	3

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 4407.

B. F. Goodrich Co.

"Cold rubber" is produced in these tanks, at a much lower temperature than for general-purpose rubber. The workman is adding to the liquid a catalyst, the substance that speeds up the process of manufacture.

SYNTHETIC RUBBER

BEFORE the second World War, most nations depended very largely upon the Orient for their supplies of rubber. Each year the United States imported about 500,000 tons from the Netherlands East Indies, British Malaya, Ceylon and Borneo. During the war it was impossible for the Allies to obtain rubber from these countries, even though the need for it was greater then than at any other time. There was only one thing to do—to produce a substitute in large enough quantities to satisfy this great need. Before the end of 1944, the United States had produced more than 1,000,000 tons of synthetic rubber. By the end of 1945, the annual production was over 1,000,000 tons.

Under normal conditions the Orient can produce about 1,500,000 tons of natural rubber a year. The countries of the world, with the exception of the United States, use about 800,000 tons a year. This leaves about 700,000 tons from the Orient for the United States. This is not nearly enough, however, for industries in the United States now use more than 1,000,000 tons a year. Because of this great need for rubber, more than 300,000 tons of synthetic rubber must be produced each year in the United States.

While synthetic rubber and natural rubber can be used for many of the same purposes, they are not the same thing. Natural rubber is made from the milky juice (latex) of certain tropical plants and trees. Synthetic rubber is not really rubber at all, but a substitute made by chemists. Its manufacture is a very complex process.

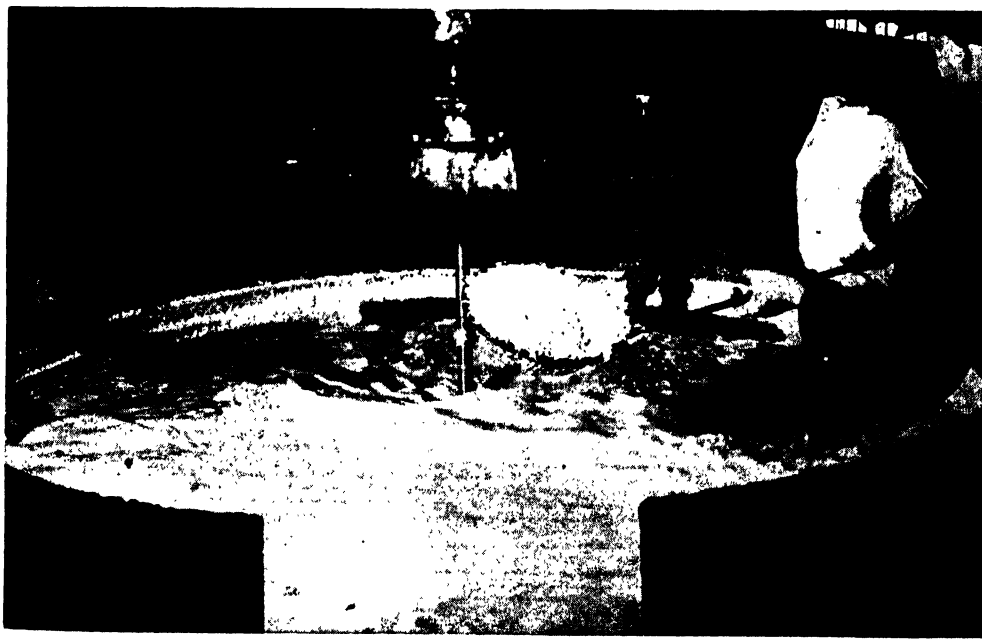
The effort to make synthetic rubber began as long ago as 1860. For years chemists tried to make rubber by putting together the exact chemicals that were found in natural rubber. The results were not successful. No great advance was made until chemists realized that they must learn how to imitate the structure of the natural-rubber molecule. That is more important than the chemical nature of the rubber. Natural rubber is

formed by the building-up of many tiny molecules into a complicated giant molecule, like a great chain. This building-up process of many small molecules into one big molecule is called by a very long name—polymerization. The big rubber molecule at rest is like a fine, wavy line 〰〰. When the rubber is stretched, the molecule unfolds ∿∿, or ———. When the rubber contracts, the molecule goes back again to its position at rest 〰〰. The synthetic rubber of today is successful because chemists have learned to make its molecules act like those of natural rubber.

During the first World War, the Germans built a synthetic-rubber plant that made about 150 tons a month. This rubber, however, was so expensive and so poor that no more was made after the war was over. In 1923, the United States Rubber Company produced a synthetic rubber by much the same process that we use today. There was, at that time, however, very little need for it since the natural rubber was so plentiful and cheap.

The first really successful substitute for natural rubber—to be used commercially—was first manufactured by E. I. du Pont de Nemours and Company in 1932. This synthetic rubber was the result of experiments made by Father Julius Nieuwland, professor of chemistry at the University of Notre Dame. It was made from acetylene (a gas composed of hydrogen and carbon). This particular kind of synthetic rubber is called neoprene. It is widely used in the making of hose for gasoline filling-stations and for tank linings, because it is not damaged by gasoline, oils or chemicals. It is much better for these purposes than natural rubber, and is used in many kinds of machinery where it will come in contact with fats and greases. Neoprene is used also in milking machines and for aprons and boots used in dairies and garages. It is not suitable for some uses; it becomes brittle at low temperatures.

By 1935 the Germans had succeeded in producing several synthetic rubbers that could be used in industry and for military purposes, especially for tires. These rubbers were made from butadiene, another gas composed of hydrogen and carbon. The Germans called this kind of rubber *Buna,* and in World War II their motor vehicles rolled on buna tires. In 1940, rubber chemists in the United States had developed methods for producing a rubber substitute from butadiene. They were now ready to make the tires of passenger cars from this new rubber instead of from natural rubber.



B. F. Goodrich Co.

When synthetic rubber is made from petroleum, the oil is changed into a milky fluid, and then made to curdle. In the strainer above are curdled particles, which are similar to natural rubber in molecular construction.

B. F. Goodrich Co.

The curds are skimmed from the vat and placed in forms where they solidify in blocks of raw "rubber." The blocks are washed and cut up into pieces, which can be handled very much as natural rubber is.

Of the four types of synthetic rubber, that known as GR-S is the most important. About 85 per cent of all synthetic rubbers are of this type and are similar to the German buna-S. GR-S can be used to replace natural rubber in most cases, including automobile tires. It is made from three parts of butadiene (which in turn is made from alcohol and petroleum) combined with one part of styrene (made from petroleum and coal tar). The initials in its name stand for Government Rubber-Styrene—synthetic rubber made first during the war according to United States Government orders.

GR-S can be used for more purposes than any of the other synthetic rubbers, and is more like natural rubber. It can be vulcanized (made stronger, harder and more elastic) with sulfur, and it can be cured to make hard rubber. It is not easily worn away by friction, but suffers damage when in contact with oil and grease. Its greatest weakness, when made into tires, is that it heats easily under heavy service, and its strength is reduced at high temperatures.

Another synthetic rubber—buna-N—is an elastic compound which has been sold under such names as butaprene, chemigum, hycar and perbunam. This rubber is made by combining butadiene with still another chemical. Its chief advantage over natural rubber lies in its resistance to oil and gasoline. Unlike neoprene, it does not become stiff at low temperatures. It can be vulcanized with sulfur and cured to give hard rubber. One of its important military uses is for the lining of gasoline tanks. It quickly seals up bullet holes.

Butyl is a synthetic rubber developed by the Standard Oil Development Company. Unlike the other synthetic rubbers, it can be greatly stretched. Gases do not pass through it. For this reason it is far superior to natural rubber for the inner tubes of automobile tires and for the construction of lighter-than-air ships. Its chemical composition is more like that of natural rubber than is that of any other synthetic rubber.

There is no synthetic rubber as yet that can be used for so many purposes as natural rubber. Some of them, however, are better for special purposes than natural rubber. Natural rubber is better suited to use in footwear and for big tires for heavy trucks that run at high speeds. Large tires at high speeds get so hot that synthetic rubber can

B. F. Goodrich Co.
In one of the final stages of the manufacture of synthetic rubber, moisture is squeezed out of the pieces and they are then pressed into sheets, as shown here, which have the look and feel of the natural product.

not be used. At least 250,000 tons of natural rubber must be imported into the United States each year for such purposes. Either natural or synthetic rubber can be used equally well for many purposes, such as floor coverings, windshield wipers, wire insulations and engine mounts.

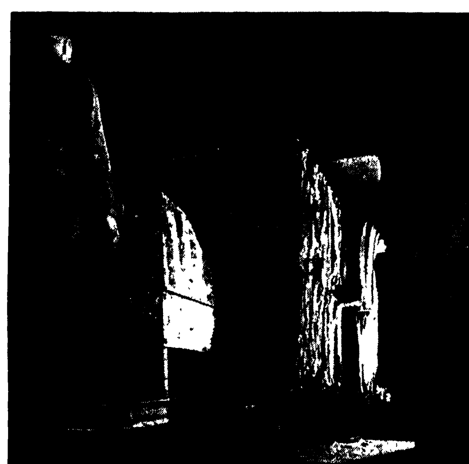
Today all synthetic rubbers are made from coal tar, petroleum and alcohol. If the petroleum supply should become exhausted, these rubbers could be made entirely from coal. It is probable that in time we shall learn how to make rubbers that will be superior to natural rubbers in every way and that will be less expensive to produce than the natural product.

In both war and peace, the production of rubber is of great importance to governments. From March 1941 through 1945, 2,000,000 tons of synthetic rubber were produced in United States Government plants.

The annual output of rubber is now approximately 400,000 tons. About one half of this is "cold rubber," a type of rubber produced at the low temperature of 41 degrees. (General purpose rubber is processed at 122 degrees.) Wide experimentation is being carried on with "cold rubber." It has already proved to be tougher and longer wearing for some purposes, such as in tire treads.

By GERALD WENDT.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4414.



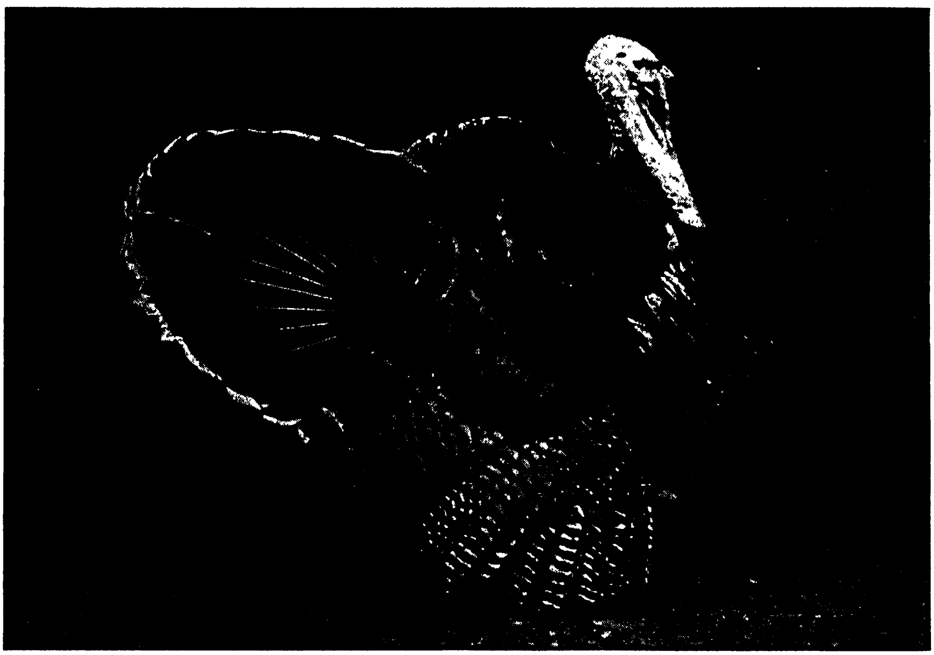
Firestone Tire and Rubber Co.
When these sheets of synthetic rubber are completely dry, they will be made into automobile tires.

THE COUSINS OF OUR DOMESTIC HENS

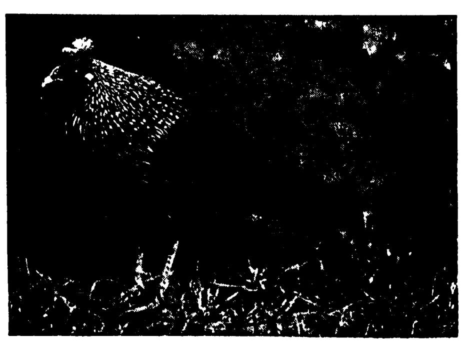

The monal.


The Argus pheasant.


The crested guinea fowl.


The turkey displays its feathers.


Elliot's pheasant.


Sonnerat's gray jungle fowl.


The Hoatzin.


A young Hoatzin.


The Tinamou.

THE PHEASANTS AND THEIR ALLIES

HERE is a tale of much in little, a survey embracing barbarous wilds in Far Eastern lands and farm yards at home, the desert with its desperate problems, mountains mantled in snow, and the mysterious Orient with beauty resplendent like a living fable. It is the story of the pheasant tribe and its allies.

It is the Sand Grouse which leads in our present array, a group of birds few in species, but at times, in individuals, as numerous as are the sands.

We meet them in the Canary Islands; they stretch out across the warmer parts of Europe; they are in Africa; they range through Asia; they flourish in the manless wilds of Siberia and Tibet like hardy flowers; and in the great Gobi Desert, where men are unearthing dinosaurs of ten million years ago, the sand grouse are vigorous and innumerable.

The home of these birds is in the parched and pitiless desert. Travelers have told this story: while the mother guards the nestlings the male undertakes a wearisome flight night and morning to some distant oasis. There, after drinking its fill, it saturates its under-feathers with water, and flies like thought back to its nest.

The baby grouse rush to meet it as it alights, nestle their heads in the dripping plumage, and, squeezing each feather through their beaks, drink and drain all dry. So thirst in their young throats is satisfied, deep in the recesses of the fiercest desert. Why do not these birds nest near a supply of water? We cannot tell, but we do know that hungry enemies of bird life are drawn to oases, and nests are probably safer at a distance which only the wings of a swift, strong bird can cover.

There is the spirit of adventure in these birds. Periodically there rises a huge tide of life in the Pallas grouse species, with their homes among the graves of the dinosaurs, half a world away. But when these tides occur the birds spread out of Asia into Europe, across the whole continent, over the North Sea, into England, and at times into every county of England. They sweep through Europe at such times, and they fly always by the same route. The migratory flights of the grouse are among the deep mysteries of nature.

There are nearly a dozen species of sand grouse, but they are all outside the true Grouse Family. In fact, naturalists now class them as nearer to the pigeons.

First we mention the Ptarmigan, a bird favored by nature. In winter its plumage is almost all white, to match

the snow of the mountains and high hills around its home. There is another suit of feathers for spring and summer, which changes to the winter coat.

This change of plumage deserves a chapter to itself, but we have only time to note that the farther north the bird goes, the more white it carries in summer. It is a bird of northern regions. Three or four species are found in Canada, but only the Willow Ptarmigan ventures into the United States.

The Blackcock is a European grouse much prized by the sportsman. The female is called the Brown Hen or the Gray Hen. The largest of all the grouse is another European bird, the Capercaillie. The sight of a male showing off before a group of females is one to be remembered. No bird makes merrier in adverse northern conditions than this high-spirited bird.

THE FATAL EPIDEMIC WHICH SWEEPS AWAY THE GROUSE

The Red Grouse, though closely related to the ptarmigans, is confined to the British Isles, where it is one of the most prized game birds. Too zealous shooting of them for a few seasons would bring about their extermination. On the other hand, too jealous a preservation of grouse by game-shooters, resulting in excessive multiplication, brings a fatal epidemic, which sweeps away the birds faster than the autumn shooting-parties.

We have several species of grouse in North America. We tell of the beautiful and interesting Ruffed Grouse and of the Canada Grouse on page 4760. The Prairie Hen, or Pinnated Grouse, a large grouse with peculiar tufts of feathers on the side of the neck was once very common in the interior of the continent. A closely allied species, the Heath Hen, found only on the island of Martha's Vineyard, is now entirely extinct. The Sharp-tailed Grouse, often called the Prairie Chicken, is seldom found south of the Canadian border, but another species, similar, except in color, is common farther south. The Sage Grouse is a large dark-colored western species, and there is also the Blue Grouse which hoots somewhat as an owl does.

A glance shows us that there is a radical difference between grouse, heavily feathered about the legs, and partridges, whose legs are free from feathers. As a matter of fact, the partridges are allies of the pheasants. Here is an enormous family, innumerable species in something like sixty groups, including all the partridges, pheasants, quails, ancestors of the poultry, the guinea fowls and the blustering turkeys.

How narrow is the dividing line may be seen from the fact that in our first example, the Snow-partridges, the rule of smooth legs is not invariable. In some the legs are slightly feathered, and the name of Pheasant-grouse is applied. Generally the birds range high up the Himalayas and Chinese and other Asian mountains, keeping between the snow and the loftiest limits of the verdure which feeds them, and flying over those dizzy ranges in the summer to nest in solitary Tibet.

THE WILY RED-LEGGED PARTRIDGE THAT AVOIDS THE SPORTSMAN'S GUN

Two kinds of partridge are common in Europe—the Gray and the Red-legged, or French, Partridge. The latter is a South European species which has been introduced into America and seems to be thriving. He is so acute and wary that it is difficult to get within range of him. We have no true partridge native to America, though in the North the ruffled grouse and in the South the common quail are commonly called by this name.

Partridges and quails are among the few wild creatures which thrive through bringing fields under cultivation. The simple fact is, of course, that most of the things we sow in our fields are food for them as well as for ourselves, and not in vain do we spread a banquet in sight of these birds.

They are very wise, as, settling in a field for the night, they form themselves into a circle with heads facing outward, so that danger, come it from what quarter it may, must be detected by their quick, nervous ears.

THE WOOD-PARTRIDGE THAT RUNS LIKE A RACE-HORSE

Another of the partridge groups bears the name of Francolins, birds numbering about forty species, ranging from Europe through Africa and away to India and China, some smaller than common partridges, some quite big birds. Another group keeps to the jungle, where men call them Bush Quails.

So far we have had ground-partridges, though the red-legged may at times perch in a tree; but we come next to several

species which make a habit of nesting in the branches of Asian forests; and also to the jungle species, called Wood-partridges, which rarely fly, but run like little race-horses. In this company we have partridges which develop crests of richly colored hair-like feathers above the brow.

Quails are common on both hemispheres, though ours differ from the Old World species, and some naturalists would deny the name to them. The bird has been known from early times, for we read how the famishing children of Israel fed upon them. The common European Quail migrates to Africa for the winter, but other species are permanent residents. The Rain Quail is common in India. The tiny Chinese Quail is bred for fighting, as other nations breed gamecocks. There are several other Old World species.

Our Common Quail, or Bobwhite, is fully described on page 4760. Though at first found only in the East, he has followed man to the Pacific coast. In the West are several species described under Birds of the West, and there are some species found only in the southern states. No bird is more lovable than this cheerful eater of seeds.

Deep in African and Asian forests are the bamboo partridges, in which two and even three pairs of formidable horny spurs sprout on the legs of the warlike males. Then we have an undoubted quail which is equally a kinsman of the pheasants, as wings and tail reveal, so we call it the Pheasant-quail, and find, in tracing out its family tree, that it leads us directly to the pheasants proper, with the handsome Blood-pheasant as its nearest cousin.

THE TERRIBLE ARMAMENT OF A LITTLE RED-COATED FIGHTER

Battle as well as beauty is here, for, while the gorgeous scarlet of the male should engage the affections of the female, each cock has four pairs of spurs, to enforce against other males the right to woo fair ladies of the tribe. Other pheasants show wonderful colors. A brush dipped in the rainbow would be necessary to give them their due coloring.

Though we have no native pheasants in North America, specimens of the most gorgeous are in most zoölogical gardens. Some men owning large tracts of land have introduced several species, and in some sections they are thriving. Their size and bright colors make them easy marks for the stealthy hunter, and they must be strictly protected if they are to survive and multiply.

In the Monal, a great beauty of the Himalayan forests, all the colors flash in metallic lustre, and the flight of one of these big birds, darting out from some mountain sanctuary, and dropping, like a rainbow-tinted gem, stone-like through the air to the foot of a precipice, is a sight at which hardened travelers hold their breath in wonder and delight.

Fiery scarlet, varied with lustrous blue and ebony black, is the color-scheme of the Fire-backed Pheasants; majestic coloring marred by bare spots on the head and face all characterize the Eared Pheasants, whose name comes from the fact that the ears proper are covered with long white tracts of feathers, decidedly ear-like in suggestion. Some of the most splendid birds of the family are among the eared pheasants.

We pass next to another assembly of the mountain forests of India and China, the kalij group. Among these we find the beauties familiar to aviaries, the Gold and the Silver Pheasants. All the pheasants and their relatives are warriors, but the silver pheasant is supposed to be the fiercest of them all. It would kill one of our common pheasants as soon as look at it.

THE FAMILIAR BIRD THAT THE ROMANS INTRODUCED TO BRITAIN

What is the common pheasant of Europe of which we read? It is very hard to say. The Romans found pheasants common in Southeastern Europe, and settled them in Britain. The birds remained when the peril of the empire called the famous legions away. About a century ago travelers brought in the Ring-necked Pheasant of China, and later the Green Pheasant of Japan. These also settled down and mated with the others, so that now we cannot be sure that any bird is the true representative of the original lines. The blood of what are called native pheasants is mixed, like that of the Englishman, who is the product of half a dozen nations.

Most of these pheasants have to be hand-reared. We can never hope to acclimatize such lovely creatures as the Chinese Golden Pheasants. We have them in our aviaries, where they are hardy and thriving, but what would have been

their fate in the woods? They crown the whole tribe. The perfect radiance of gold and scarlet leads scholars to believe that the golden pheasant was the phœnix of old legends, the bird of fire which renewed itself from its own ashes.

There are many other species of pheasants which we cannot stop to mention, but must pass on to our domestic poultry. Where pheasants end poultry begin. The resemblance may not be plain, but watch a flock of healthy cockerels running uphill, with the necks craned forward and the tails drooping down, and at a distance one cannot say whether they are pheasants or poultry.

THE JUNGLE FOWL AS THE ANCESTOR OF ALL DOMESTIC POULTRY

We have here a parallel to the case of the dog, the cattle, the sheep, the pigeons. Though there is some little doubt, the bulk of testimony goes to show that we can place our hands on the red jungle fowl of India and say: "You are descended from predecessors which have given us, under the selecting hand of man, every breed of domestic poultry in the world." There are other jungle fowl to-day, as there have always been, and many students think that perhaps some of our domestic fowls are descended from the gray species. In other words, the blood of both lines has gone to make our domestic breeds of fowls. See page 4491.

Civilization in the East is extremely ancient, and it is believed that the taming of jungle fowls into domestic poultry dates back thousands of years. Pictures of jungle fowl have been found in the tomb of Tutankhamen, which shows that the Egyptians had received the bird in the way of commerce from the Far East, thirty centuries before poultry was a commonplace of Grecian farm yards.

WHY A HEN LAYS THREE HUNDRED EGGS IN A YEAR

The instinct of a hen is to lay, perhaps, a dozen eggs, brood them, and lead off her chicks in clucking triumph. What we have done is to steal her eggs, day by day, so inciting the hens to the hopeless effort of still filling that constantly emptying nest. The more a hen could be encouraged on these lines, the more her value increased, and the more valuable became the chicks which did eventually hatch from a single dozen of her eggs. From generation after generation of such hens have come birds which rival butterflies and moths in the number of the eggs they lay—over three hundred eggs a year in spite of molting time.

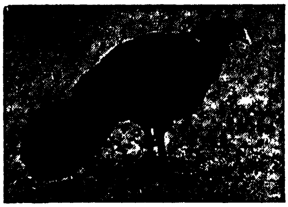
What wonders men have achieved in the development of poultry varieties! There is the bantam, all vanity and valor; there is the great game bird, set up on spurred stilts, which will fight to the death for the love of combat; there are Japanese varieties with tails so long that the owners must perch fifteen feet high; besides the more ordinary sorts.

Though the jungle fowls are not actively migrating birds, their descendants, transformed into scores of different varieties, have been carried wherever civilization has gone. There are hundreds of millions of hens in the world to-day, outnumbering the wild species a thousand to one.

We shall not stop here to speak of the different breeds of domestic poultry. You will find many of them described and pictured, some in color, in the next chapter on Animal Life.

From the poultry we pass to more pheasants, which are on the peacock border line, and we find a celebrated beauty in the Argus Pheasant. Its elaborate plumage is starred with innumerable "eyes." We should imagine that such wealth of ornament could not be excelled if we did not immediately encounter a still more highly-decorated marvel in the Peacock itself, perhaps the supreme marvel of all India's gorgeous creatures. "Beauty is truth," sings one of our poets, and in India, where the peacock is concerned, beauty breeds superstition. The natives think it evil and dangerous to kill the peacock. The peacock, which is such a familiar sight as it struts proudly to and fro inviting admiration, is actually a native of India and Ceylon. Solomon speaks of it, and the pea-fowl was introduced to Europe a very long time ago. The gorgeous train the male bird is so fond of displaying is not made up of the tail feathers, as is usually supposed. The feathers of the train are actually a screen for the upper tail, and the true tail may be seen helping to support the train when it is spread. Africa has many natural living riches, but she cannot compare with Asia in pheasants, for the Guinea Fowl is her only child of the great race. There are several species of this bird which was kept by the Greeks and Romans but later dis-

MEMBERS OF THE PHEASANT TRIBE

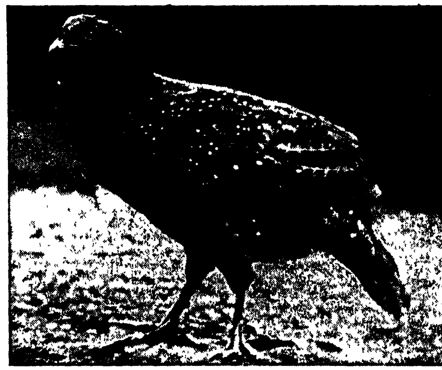


The brush turkey.

A curassow.

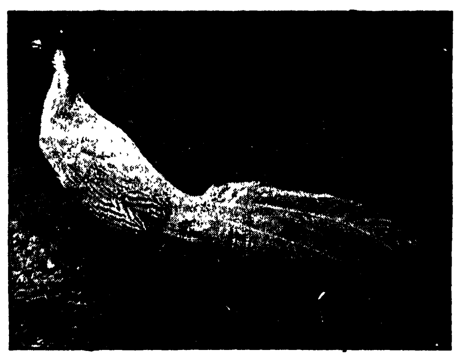
The red-tailed guan.

The common turkey.



The horned tragopan.

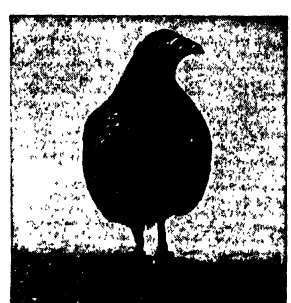
The Javan peacock.



The silver pheasant.

The black-throated tree-partridge.

The Mongolian pheasant.



The double-spurred francolin.

appeared from Europe until brought in again by the Portuguese. We have several varieties in captivity, but the bird has never been really tamed. It is still shy and dislikes to be too close to human habitations.

It is a desirable bird, but America has given the world one more important in the Turkey. The bird with which we are all familiar had been domesticated in Mexico long before Columbus reached the New World. It had been transported to the West Indies, too, and there the great Genoese found it and brought home live examples to show that he really had touched new land. Since then it has been carried far and wide, and called turkey by the British because it came in ships which traded with Turkey; but in Spain and France called Indian fowl, in the belief that its home, America, was the India of Columbus' dreams.

Formerly the Wild Turkey was common over the greater part of the continent. It is now almost, if not quite, extinct in Canada and the more thickly settled parts of the United States, but in the South and West some still remain in the wilder regions. By selection several distinct breeds of domesticated turkeys have been developed. The American Bronze is supposed to have come from crossing domesticated turkeys with wild specimens and is the largest of all.

No land but America produced a true turkey, but there are rather similar birds, the Brush Turkeys, in the Australian regions and elsewhere. Bodily they resemble the true turkey, but Australia has one hideous example, whose head is bare like a vulture's.

THE NATURAL INCUBATORS IN WHICH THE TURKEYS PLACE THEIR EGGS

Some species have the extraordinary habit of scratching huge mounds of rotting vegetation and leaving their eggs in them, to be incubated by the heat of the decomposing mass. Some are said to place their eggs in mounds of earth warmed by the hot waters of subterranean streams. In any event there is not the slightest care for the young.

Many eggs are laid in such an incubator, all placed with the narrow end downward so that the chick, when hatching, is head uppermost. As soon as the eggs are broken, the little ones wriggle out of the mound, and run for their lives to hiding in the bush, uncherished, unsought, but not unguarded. Nature is their nurse, and all is well.

South America gives us the Curassows and the Guans, and a bird in some respects the most primitive of all, the Hoatzin. The young are born with great claws to those parts of the wing corresponding with the thumb and first finger of a human hand. With these claws, aided by the beak and feet, the little creatures crawl like ungainly lizards about the branches of the riverside tree in which they have been cradled.

At the least alarm the naked adventurers throw themselves into the water, swim to hiding, and, when all is apparently safe again, crawl from the water and back to their nest. If we try to imagine a baby sparrow or a baby eagle leaping from its nest to swim in deep water, and then ascend again to its nest, we see how astonishing is the feat accomplished in these ungainly wonders of the wilds.

Next we find the Tinamous of South America. Ranging in size from the partridge to the common pheasant, they resemble the game birds in general, but have points of structure clearly suggesting relationship to the towering ostrich. For perhaps uncounted years they have had the freedom of the grassy plains of South America, and have found running as effective as flight; so they run much more than they fly.

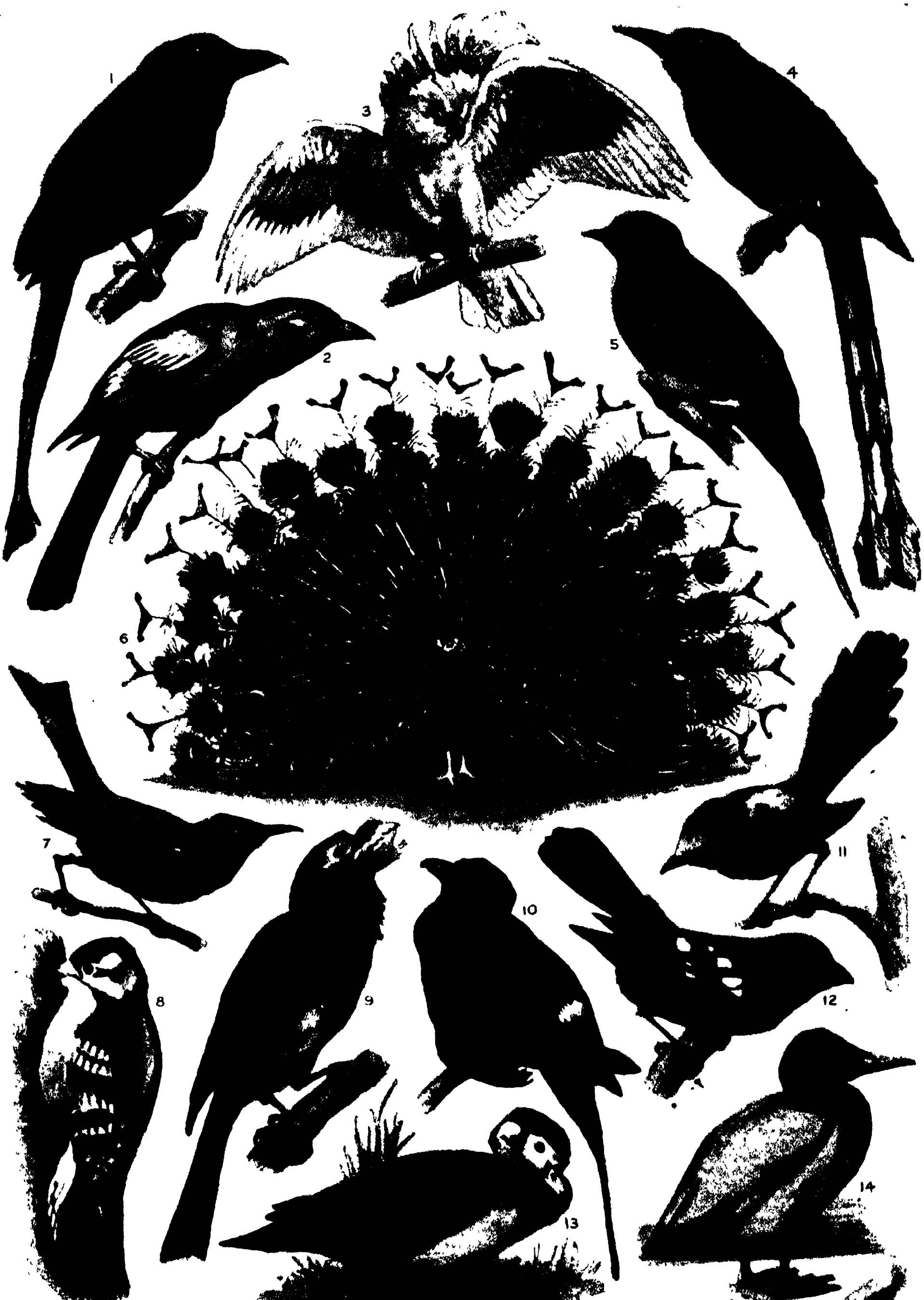
We know they were better airmen in past days from the fact that young tinamous, bringing into the world a fresh heritage of force, fly with greater zest and facility than do the old birds. With maturity comes increasing indolence of wing, greater aptitude for walking. The result is that, as men increase, tinamous decrease.

THE BEAUTIFUL EGGS OF THE TINAMOU OF SOUTH AMERICA

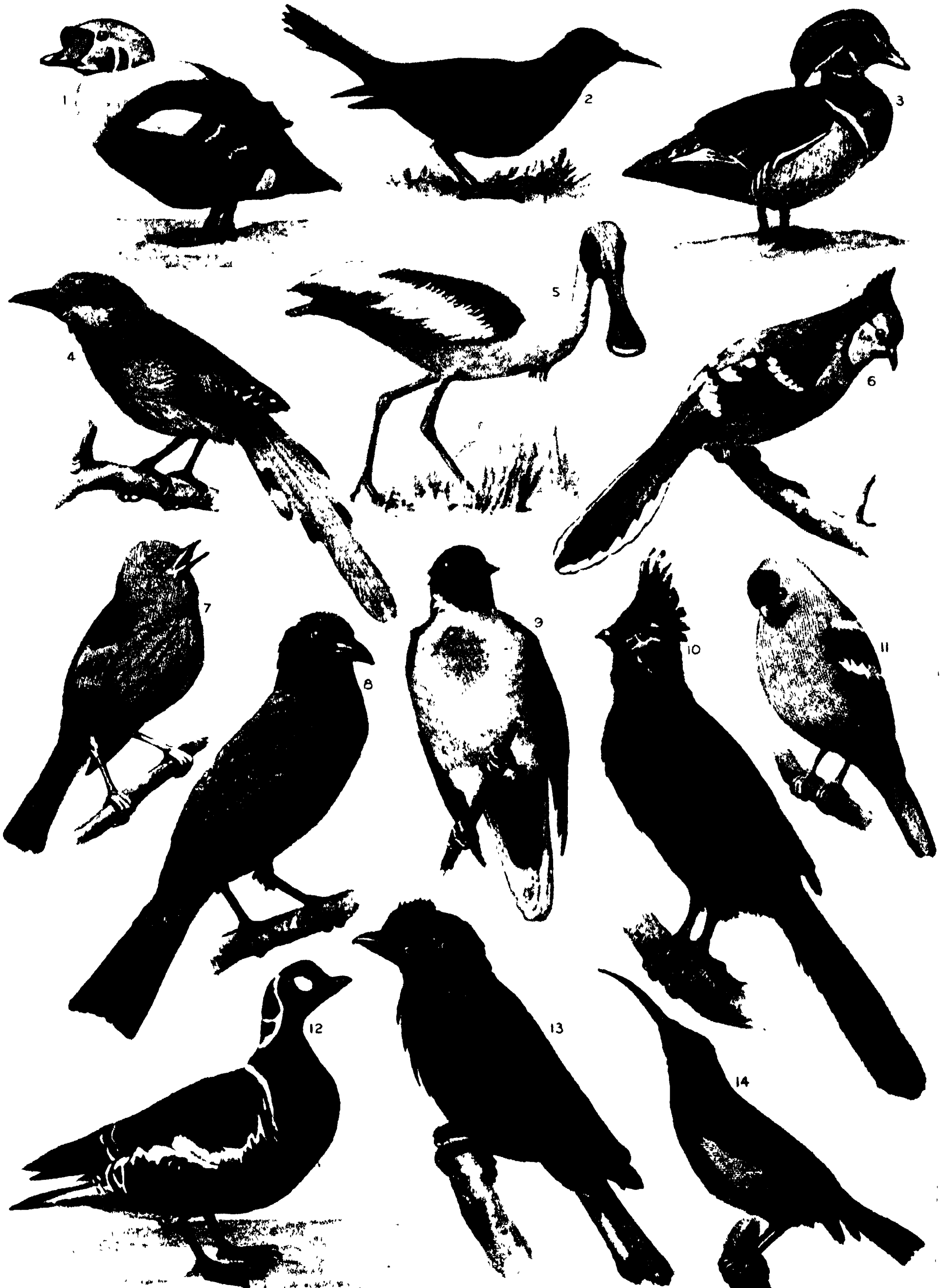
If we lose the tinamous we shall sacrifice the master creators of beauty in the world of eggs. What purpose is wrought in the superb sheen of a bird's egg none can say, but tinamou eggs are the marvel of their kind. Each egg is a masterpiece of enamel and tinting. Varying in size and hue, the eggs are all enameled like a lovely piece of porcelain. The wise craftsman of China, who gave us that precious ware, produced nothing more perfect and exquisite than these shells.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 4492.

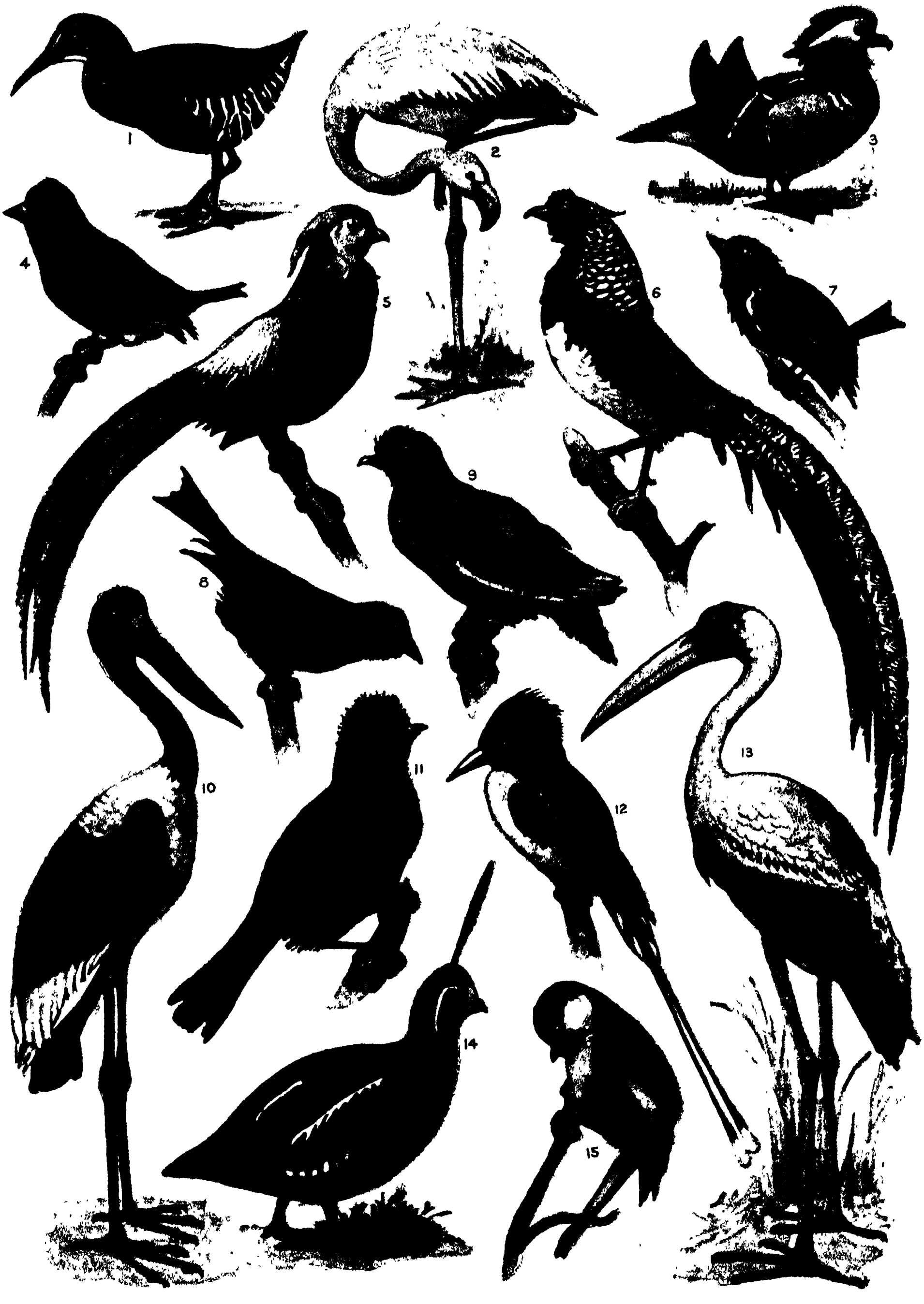
BEAUTIFUL BIRDS OF THE WORLD (II)



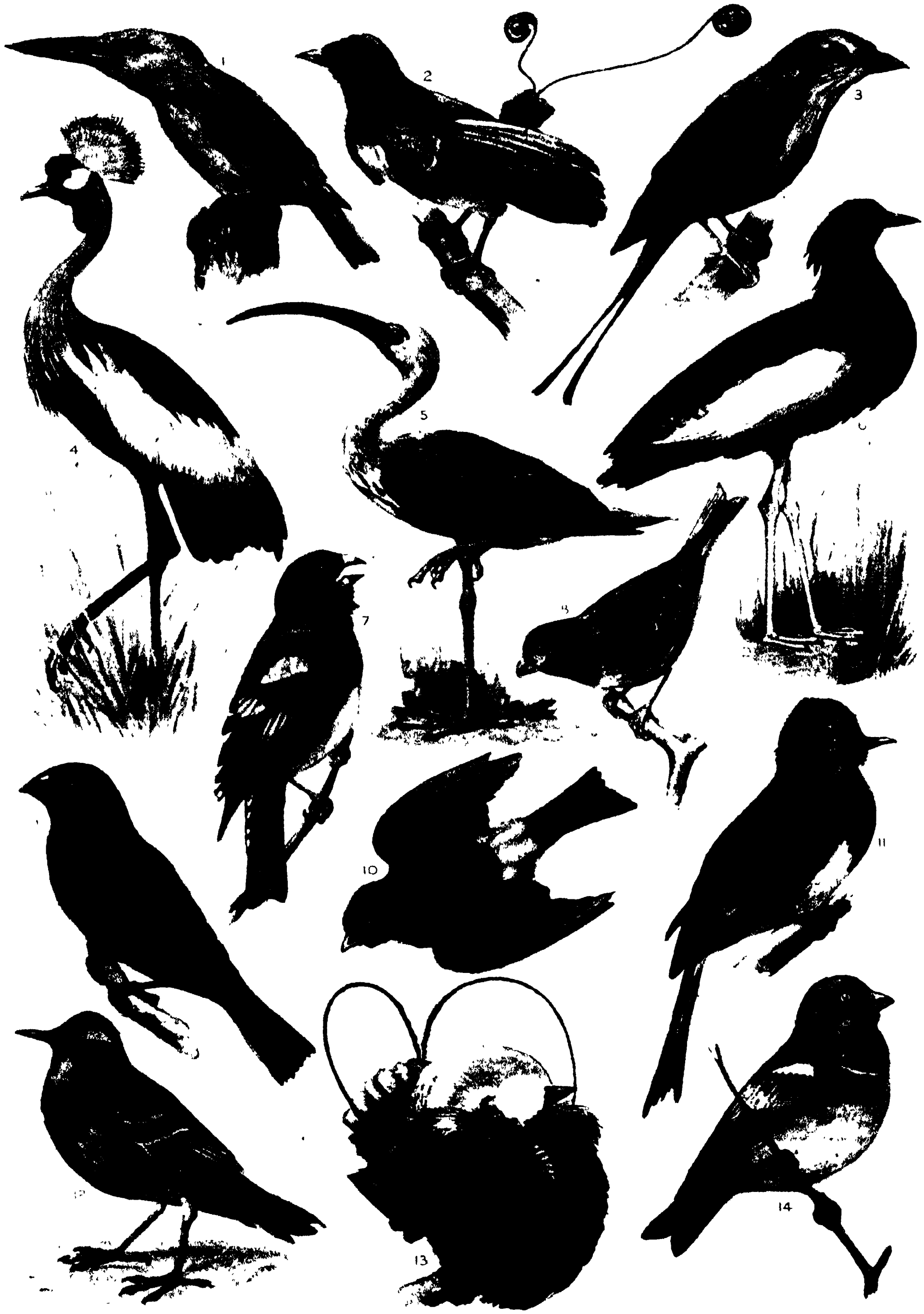
1. Blue-crowned Motmot. 2. Bullock Oriole. 3 Leadbeater's Cockatoo. 4. Racquet-tailed Motmot. 5. Short-billed Minivet. 6. Peacock. 7. Gold-fronted Green Bulbul. 8. Downy Woodpecker. 9. Groove-billed Barbet. 10. Duvaucel's Trogon. 11. Red-winged Wren. 12. Black-lored Red Tanager. 13. African Pigmy Goose. 14. Canvasback Duck



1. King Eider Duck. 2. Cardinal Honeysucker. 3. American Wood Duck. 4. Green Magpie. 5. Roseate Spoonbill. 6. Blue Jay. 7. Yellow Warbler. 8. Indian Fairy Bluebird. 9. Jambu Fruit Pigeon. 10. Livingstone's Turaco. 11. American Goldfinch. 12. Red-breasted Goose. 13. Crimson Fruit Crow. 14. African Double-collared Sun Bird.



1. Virginia Rail. 2. Flamingo. 3. Mandarin Duck. 4. Red Siskin. 5. Golden Pheasant. 6. Lady Amherst's Pheasant. 7. Orange-headed Manakin. 8. Blue-headed Warbler. 9. Orange Fruit Pigeon. 10. Saddle-billed Stork. 11. Red Chatterer. 12. Small Racquet-tailed Kingfisher. 13. African Wood Ibis. 14. California Mountain Quail. 15. Blackcap Titmouse.



1. Senegal Kingfisher. 2. King Bird of Paradise. 3. Long-tailed Roller. 4. South African Crowned Crane. 5. Scarlet Ibis. 6. Bengal Florican 7. Black-headed Grosbeak. 8. American House Finch. 9 Blue Grosbeak 10. Paradise Tanager. 11. Indian Black-naped Flycatcher. 12. Varied Thrush. 13. Hunstein's Bird of Paradise. 14 Lazuli Bunting

GOLF FOR BOYS AND GIRLS

GOLF is one of the oldest as well as one of the most popular of games. A game suggesting modern golf was played by the ancient Romans with a mallet and a leather-covered ball. Later the French and the Dutch played a game in which the ball, struck by a club, was aimed at an upright marker. It was the Dutch who gave the game its present name, for the word golf comes from the Dutch word Kolf, meaning club. The Scotch introduced a new feature; they made holes in the ground and tried to get the ball into the holes. The game found so many enthusiastic followers in Scotland that in the fifteenth century it was forbidden for a time; the authorities feared that it might replace the old sport of archery. They also feared that a game which was played so seriously might have a bad effect on the conduct of the players! Golf is as popular as it ever was in Scotland.

The game spread to the United States and Canada about the middle of the nineteeth century and it became firmly established in the nineties. At present the game is one of the four or five outstanding sports in both the United States and the Dominion.

To people who know nothing of golf the game seems to be a very simple one, for after all does it not consist of hitting a small ball a series of blows with a club? The object of these blows or strokes is to get the ball into the *cup,* an artificial hole in the ground. Starting from a place called the *teeing ground* or *tee,* the player hits the ball in the direction of the cup; he must [illegible] to get it into the cup in as few strokes as possible. The distance from tee to cup, which varies from 100 to more than 500 yards, is called the *hole.* Golf is played on specially prepared courses called *links.* A golf course generally has 18 holes, though some small courses have only 9.

The player, as we have seen, drives off from the tee. This is a level, smooth plot, generally provided with a box containing sand. In order to get a freer shot at the

Courtesy, A. G. Spalding and Bros.

1. A great American golfer—Horton Smith.

ball, the player is permitted to set it upon a support an inch or so above the ground. Some players take a little sand from the sand-box mentioned above. They make a little pyramid of sand upon the ground; upon this pyramid, which is called the tee, the ball is set. Many players nowadays use a wooden tee. This is a sort of inverted cone; its upper surface is slightly hollowed out so that the golf ball may rest upon it. The sharp end of the cone is set in the ground and upon the upper surface the ball is placed.

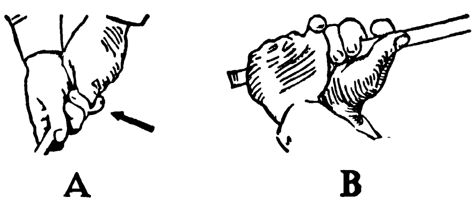
The player is supposed to follow a definite course from tee to cup. This course, a fairly broad avenue of turf, is called the *fairway.* It is indicated by flags set at intervals along it. If the player sends his ball off the fairway, he is apt to come upon a *hazard*—that is, any tall grass, trees, fences, ditches, ponds and the like that make it difficult, or, in some cases, quite impossible to play the shot.

Generally Nature provides plenty of hazards. Sometimes artificial ones are made; these generally consist of raised earth banks with a trough or wide hole on one or more sides. Often sand is put in the troughs. A hazard of this kind is called a *bunker.* Sometimes natural or artificial hazards are set across the fairway and may form a trap for

the unwary golfer. A player may avoid a trap by directing his shots so as to fall short of the trap or else to clear it.

The player is permitted to make a tee for his ball only when he drives off. After that he must play the ball wherever it lies. Any *loose* stones or earth within a club's length of the ball may be removed in order to clear the way for the next shot. However the player is not permitted to move, bend or break off anything fixed or growing near the ball. If the ball is so placed that it cannot be played, the player may move it, adding one to the number of strokes that he takes for the hole.

If a player cannot find his ball within five minutes after a shot is made, the ball is



Courtesy, Bell Syndicate.

2. The golf grip. A: Overlapping grip; little finger of right hand rests on index finger of left hand (see arrow). B: Holding club in backswing.

considered lost. He must add another stroke to the number recorded for the hole, and he must put another ball in play near the place where the ball was lost. If, in striking the ball, the player displaces the' turf, he must put it back in position. This displaced turf is called a *divot.*

After a certain number of strokes (from one to ten or even more) the player will find himself near the cup. This is surrounded by a grassy plot, which is known as the *putting green* (or simply *green*), because upon it only short strokes or *putts* are taken. The shape and dimensions of the putting green are not fixed; generally, however, it is laid out in the form of a square, each side of which measures 10 yards or more. The turf on the putting green is cut very short and it is rolled so that it may be just as smooth as possible.

The cup is really a cylindrical socket set in the ground; it is 4½ inches in diameter. An iron flag, which bears the number of the hole, is set in the cup. This flag is generally removed from the cup when a player is on the putting green.

When the player has put the ball into the cup at last, he calculates the number of strokes it has taken him to do so. In adding up his score for the hole, the player must include all strokes, even those which barely touched the ball or missed it entirely. He then walks over to the tee of the next hole and drives off, as before.

Sometimes golfers play only 9 holes, or even fewer, particularly if they are pressed for time. Generally, however, they play 18 holes at a time; this is called a *round.*

GOLF SCORES

Of course a player's score at the end of the 18 holes will depend upon his skill. A novice may take 100 strokes or more to complete the course; an expert may finish the 18 holes in less than 70. However, if a player's score depends to a great extent upon his skill, it also depends upon the course. Some courses are quite easy to play; hazards are not numerous and may be avoided by moderately skillful players. Other courses are difficult even for experts. A score of 72 on some courses may represent a finer performance than a 68 scored on an easy course.

Golfing associations recognize the difference between courses by setting up what is known as *par* for the course. Par represents the number of strokes that an expert golfer should take if he plays each hole correctly and without mishap. Seventy-two is par for the average course; for certain courses par may be several strokes less or more.

HOW PAR IS SET UP

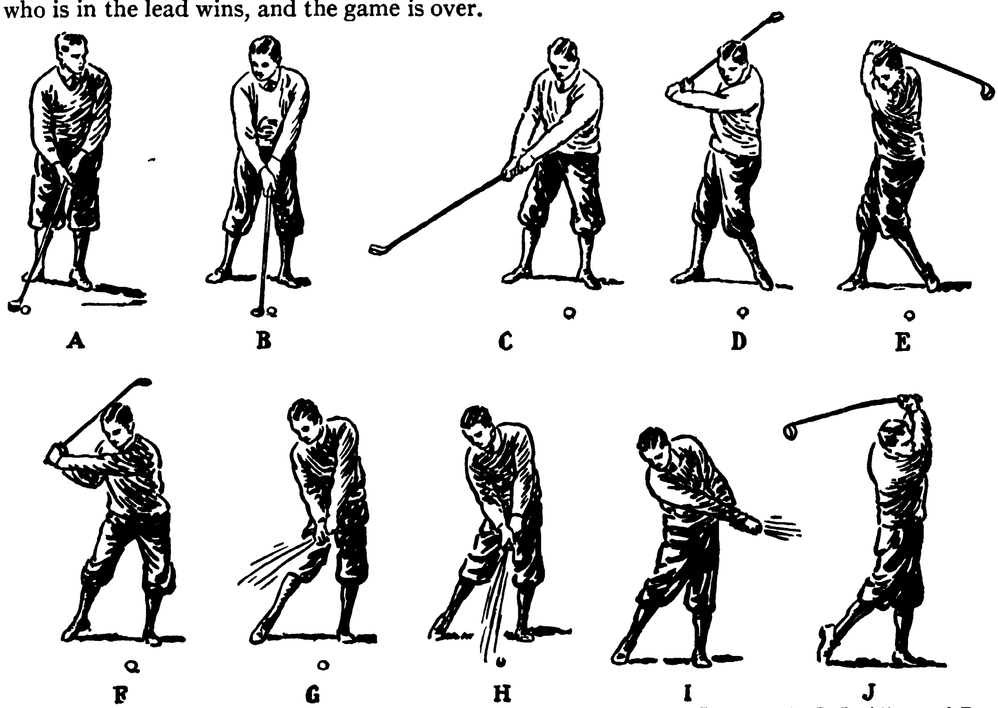
Par is set up for each hole of the course, as well as for the course as a whole. Par for any given hole is generally 3 for any distance under 250 yards; 4 for distances of from 250 to 450 yards; 5 for distances over 450 yards. A player may play a hole in par or in one or more strokes above or under par. If he plays the hole in one stroke under par, he is said to have made a *birdie.* He makes an *eagle* if his score is two under par for the hole. The rarest shot in golf is a *hole-in-one*: the player, driving off from the tee, sends the ball right into the cup. Such a shot is rare and it is as much the result of chance as of the player's skill.

Thus far we have considered only individual scoring. When a golfer plays against one or more opponents, there are various scoring methods. In *match play* between two opponents, each hole must be counted separately. The player taking the fewer strokes for a particular hole wins that hole. If both players take the same number of shots for

the hole, we say that the hole is halved. The match is halved when both players have the same number of holes to their credit.

The player in the lead is said to be one up when he has won one more hole than his opponent, two up when he has won two more holes than his opponent. Sometimes the match is in doubt up to the 18th hole. However, the game may be decided in 17 holes or even fewer. If at any time the number of holes that a player is up exceeds the number of holes still to be played, the player who is in the lead wins, and the game is over. For example, suppose that player A is 2 up at the end of the 17th hole. Even if player B won the 18th hole, he would still be one hole behind his opponent. The game comes to an end, therefore at the end of the 17th hole. We say in this case that A wins by a score of 2 up and 1 to play (that is, one hole to be played). Sometimes a player may beat an opponent by as much as 10 up and 9 to play, though such scores are not at all common when players are evenly matched.

If one golfer plays against another, the match is called a *single* or *twosome*. If two play against two and each side plays one ball (the partners alternate in driving off and also in the following shots for each hole), the match is called a *foursome.* If a single golfer plays against two who play one ball, the match is called a *threesome.* Sometimes two players play their better ball against the better ball of two other players; that is, each partner plays his own ball, and the better score that is made counts as the side's score for that particular hole. Such a match is called a *best ball, four-ball match.*



Courtesy, A. G. Spalding and Bros.

3. This series of photographs illustrates the drive. A, B. Preparing for the stroke. C, D, E. Backswing. F, G. Down-stroke. H. Contact with ball. I, J. Following through.

Foursomes are not very popular in the United States. In fact many players apply the name foursome to a best ball, four-ball match—a rather confusing practice.

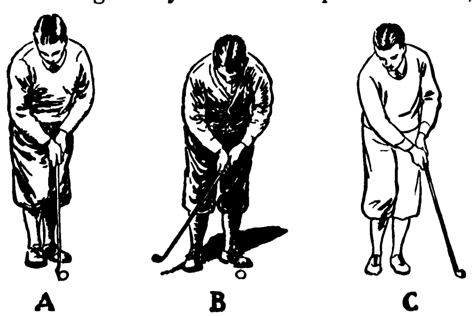
Thus far we have been discussing match play. In *medal play,* the golfer who completes the whole course in the least number of strokes is the winner. Some golfers excel at medal play, others at match play.

Some golf tournaments are based on match play, others on medal play. In match play the players are paired in a series of matches and the winners play against each other. as explained on page 5890. In medal play

four rounds or 72 holes are played. In the case of ties, the committee that is in charge of the tournament decides how the ties are to be played off.

We have discussed some of the more important rules of golf. There are many more, which are contained in several codes. Throughout the British Isles the players follow the rules that have been set by the Royal and Ancient Golf Club of St. Andrews in Scotland. In the United States golfers follow the code of the United States Golf Association. The American rules, however, are much the same as those of Great Britain. Competition between these two countries has helped to keep these rules more or less uniform.

Although they are often quite detailed,



Courtesy, A. G. Spalding and Bros.

4. Putting. A. Stance (position) before the stroke. B. The backswing. C. The Stroke.

golf rules are not at all difficult to understand, and any boy or girl can learn them in a comparatively short time. However, it is not enough to merely know the rules if one is to play a good game of golf. The player must acquire the mastery of many different kinds of strokes. Besides, he must use golf balls that are true in flight and golf clubs that are well balanced.

The golf ball is made up of a great number of rubber strands wound around a central core of hard rubber or steel. Sometimes the core consists of paste or liquid in a rubber container. The outer casing for the cover is made of gutta-percha.

There are a number of different kinds of clubs; for the average golfer six are quite enough. For driving off, a wooden-headed club, called a *driver,* is used. The *brassie,* which also has a wooden head, is used for long shots on the fairway. The other clubs have iron heads. The *midiron* is used for moderately long shots on the fairway. The *mashie* is used to approach a putting green. The *face* or head of this stick is laid back at an angle; this makes it easy for the player to loft the ball over any obstacle. The *niblick,* the face of which is laid back still more, is used to get the ball out of a bunker or rough ground. The *putter* is a short club with a straight face; it is used to play the ball from any spot on the green.

To master golf strokes it is best to take lessons from a good teacher, who can show you by example just how each stroke should be made and who can point out and correct your faults. The beginner will also learn a great deal from such books as Golf Fundamentals by Seymour Dunn and How to Play Golf by I. Brown. Here are some helpful suggestions.

It is very important to learn how to grip the club correctly. It must be grasped in the fingers with both wrists above, and it must not be held in the palms of the hands (see figure 2, A). In the overlapping grip, which is widely used, the little finger of the right hand overlaps the index finger of the left hand (figure 2, A). When the club is swung, the grip should be secure, but the club should not be squeezed. Most pressure should be exerted by the three smaller fingers of the left hand (figure 2, B).

HOW TO DRIVE OFF

In driving off, the golfer must stand in an easy position opposite the ball. His feet should be about a foot and a half apart and the weight of the body should be evenly distributed between the two feet. When he begins his backswing, the golfer should fix his eyes on a point just behind and beneath the golf ball. He swings the club up and behind the back of the neck. His weight in the meantime has been partly shifted to the right foot, while the left heel is drawn off the ground. With the forward swing, the shoulders turn around and the weight passes from the right foot to the left. The series of pictures in figure 3 shows how the stroke is carried through.

This stroke is really the basis of most golf shots. In playing with the midiron and mashie the same principles are employed. In these strokes, however, the club is generally not carried up so far in the backswing.

In putting, the feet are kept closer together, with knees relaxed. The hands are closer to the body, the left elbow being held clear of the side. The backswing is just long enough to allow smooth stroking. The stroke is through the ball directly along the intended line of the putt (see figure 4).

FIRST AID TO THE INJURED: LESSON I

WHAT TO DO WHILE WAITING FOR THE DOCTOR

IN this lesson and in those that follow we are going to learn what to do in case of accidents of various kinds—fractures or broken bones, hemorrhage or bleeding, sprains, burns, bruises, poisoning, scalds and the like.

We must understand that first aid is not intended to take the place of the doctor's work. In all cases of serious accident we should call a doctor to the patient's side as soon as possible. But while we are waiting for the doctor to come, we should do what we can to relieve the patient and to prevent his injuries from becoming more serious. If the patient has cut himself, the bleeding must be stopped at once; if he has broken his leg, the broken bone must not be allowed to do any further injury. In all cases the patient must be placed in such a position that

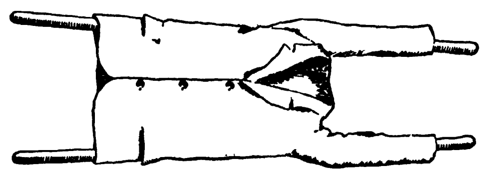
1.

he will suffer as little pain as possible. It is to help every boy and girl to know how to do these things that these lessons in First Aid to the Injured are being given to our young readers.

If we are going to be successful and useful in this most valuable study, there are a number of things that we should always bear in mind. We should always be on the alert, so as to render help as soon as an accident occurs. We should be resourceful; we should use whatever there is on hand if the proper bandages and splints and stretchers are not available. We should always remember that an injured person should have plenty of air. If the weather is at all cold we should keep the patient warm by wrapping a coat or robe or some other article of that sort around him.

For broken arms and legs splints are needed—that is, something solid and firm to which the arm or leg may be bound so that the parts above and below the fracture may not move independently of each other. For this purpose all kinds of things are useful—umbrellas, baseball bats, broom handles, canes, pieces of wood and so on. Before being applied these objects should be padded with a coat or some handkerchiefs or sacking—anything soft, in fact. We shall learn later on how to apply a splint.

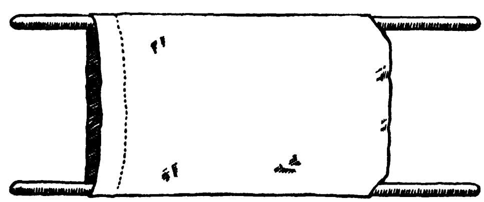
Now we take up the matter of bandages. Bandages are of very great importance in most cases. It would be well to keep a supply of roller bandages on hand. These are strips of linen, calico or muslin of different lengths and widths. If bandages of this



2.

type are not available, you may make serviceable bandages of handkerchiefs, neckerchiefs or bandanas, folded over. Bed sheets or table-cloths may be torn into long strips and used as bandage material. No matter what sort of material is used, you should be sure that the portion of the bandage that is to come in contact with the wound is perfectly clean. A dirty bandage might cause a serious infection and in some cases would be worse than no bandage at all.

We shall learn later how bandages are to be used for different injuries, but it is nec-

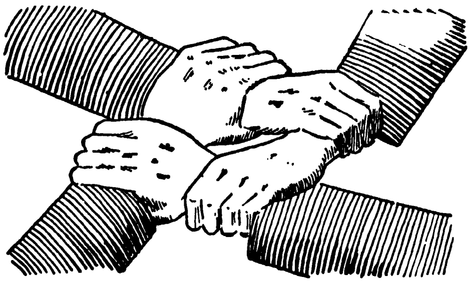


3.

essary for us to know how to tie the bandage when it is on. It is best to use the reef knot that is shown in figure 1. This is an easy sort of knot to make and with a little practice you will be able to make it very quickly. You will find, too, that it will secure the bandage effectively.

When a person meets with an accident it is often necessary to remove some of his clothes—possibly a coat or a shoe or a stocking. This has to be done very carefully. In removing a coat we take it off the uninjured side first; then, if necessary, we cut the stitches of the seam in the sleeve

and lining and lift the coat away. A shoe should be untied and the back seam cut open carefully. Stockings or socks can be cut away from an injured foot with scissors or a sharp penknife. Remember that the



4.

clothing must never be pulled from the injury in the case of burns and scalds. You should cut around any part of the clothing adhering to the injury, and leave the rest for a physician to attend to.

One should always exercise the greatest care in lifting and carrying an injured person. In the case of injury to the back it is best to wait for the doctor's arrival. In other cases it may be necessary to move the patient before a doctor's arrival.

If no stretcher is available, we can make one by buttoning up a coat and slipping poles through the sleeves and along the sides of the coat, as shown in figure 2. Be sure that the buttons of the coat will hold under the strain. It would be well to use safety pins to provide added security. A single coat would be large enough for a small child. If a larger stretcher is needed, two coats may be set in place on the same poles.

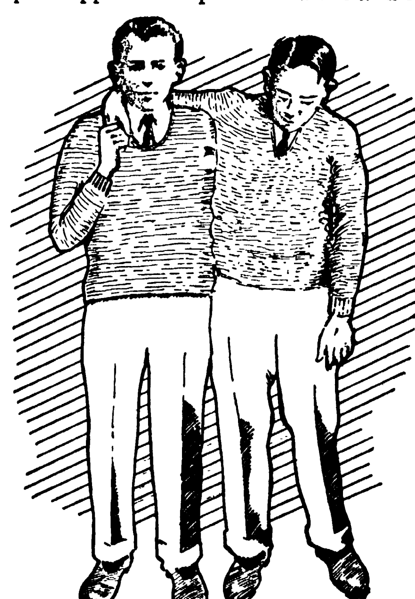
A pillow-case is sometimes used in order to make a stretcher. The closed corners of the pillow-case are first snipped off with a pair of scissors or cut off with a knife, and through each hole is placed a pole, broomstick or mop-handle, as shown in figure 3. Two or more pillow-cases may be used to form a single stretcher, the same poles, of course, being used for both. Sacks may be used in exactly the same way.

Every stretcher should be very carefully tested before it is used, so that you may be certain that it will bear the weight of the person who is to be put upon it.

If shutters are available they may be used effectively as stretchers. Coats should be placed upon them, so that the patient may be as comfortable as possible.

In lifting a patient upon a stretcher there must be gentle, steady effort without any jarring. If an arm or leg is injured, some helpers must support the injured limb. The head should also be supported. The bearers of the stretcher should be of the same height, or as nearly of the same height as possible. The stretcher should be carried quite horizontally.

In some cases the patient may be carried on a seat made by the arms of the helpers. If only two helpers are present, they may make what is called a two handed seat. For this the two face each other and stoop down, one on each side of the patient. They each place one arm under his back just below the shoulders; the other arms are passed under his legs, the legs being clasped. If three helpers are present, an even firmer seat—the four-handed seat—may be made. In figure 4 we show you how a four-handed seat is made by two of the helpers. The third helper supports the patient's back and head.



5.

If there is only one helper for an injured person and his injury is not serious, he may be assisted in the manner indicated in figure 5. The helper should grasp the injured person firmly around the waist.

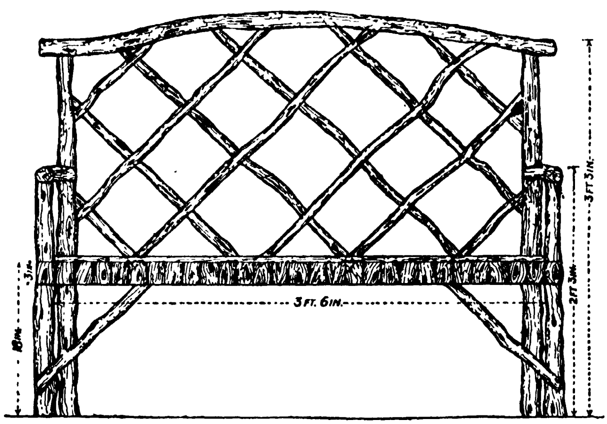
In the next lesson on first aid, on page 4621, we shall discuss the various bones and arteries of the human body.

HOW TO MAKE A RUSTIC BENCH

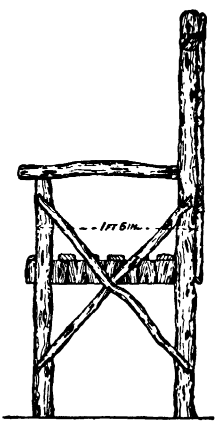
IT is not at all difficult to make a rustic bench, and it will be an extremely attractive and practical piece of furniture for your lawn or garden.

The illustrations show a bench in which rustic work (that is, the use of untrimmed branches and boughs) is combined with a square framework. Figure 1 is a view looking from the front; figure 2 is an end view. Figure 3 shows us the bench as it looks when seen from above.

For the framework, which is seen in figure 4, we shall need six pieces of lumber, measuring 3 inches deep by 2 inches wide in cross-section. There will be two ends, two sides and two cross-pieces. The length of each of these pieces is indicated in figure 3. Of course we may make these boards longer or shorter according to the dimensions of the bench that we wish to construct.



1. Front view of rustic bench.



2. End of bench.

The framework for the seat has to be fitted to four uprights, which can be made of untrimmed fir poles, as shown in the pictures. These must be fitted accurately, or else the bench will not be steady. At a distance of 18 inches from the bottom of each upright, mortises must be marked out and cut (see figure 4). Note that the faces of the mortises are at right angles to each other.

Tenons must now be cut on the ends of the side and end pieces of the framework; these tenons are to fit the mortises of the four uprights. As shown in figure 4, these tenons will be cut so as to form an angle of 45 degrees. The tenon of a side piece will thus fit tightly against the tenon of an end piece, as indicated in figure 4, and this will make your bench very steady indeed.

Before fitting the tenons and mortises together, fit the cross-pieces of the framework in place so as to fasten the two end pieces together. Wedge these cross-pieces into position as shown in figure 3. Then fit the tenons and mortises together and secure them by nailing them or screwing them together. This is by far the most complicated part of your work.

Two pairs of sloping pieces, or angle-struts, are shown supporting the seat in figure 1. These are nailed to the under part of the end pieces and to the legs.

Next we are to set the elbow rests into place; these are shown in figure 2. These elbow rests are formed of round poles, each being slightly flattened on one side. They are tenoned into the back uprights and are nailed upon the front ones.

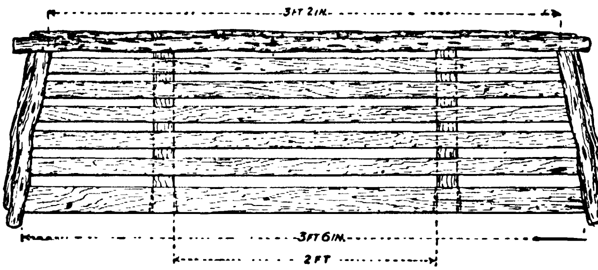
We must also fit diagonal struts at the ends, as shown in figure 2. These are made of untrimmed branches, cut to angles of 45 degrees at the ends. They are nailed or screwed (preferably screwed) to the legs.

The back can be made of a crooked branch, not necessarily of the shape shown in figure 1. The back is nailed or tenoned to the back uprights. It is then stiffened by the crossing rustic work at the back, like that in figure 1. This may be nailed or screwed into place; screwing, however, always makes a firmer job. The seat is made of five slats of ½-inch or ¾-inch board. They are nailed with openings between them in order to allow the rain to run off, and they are slightly rounded at the top for the same reason.

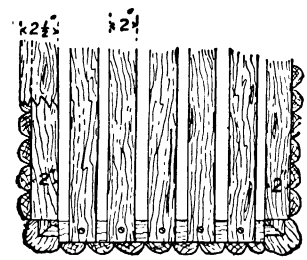
The rustic appearance of the bench will

be made much more striking by the addition of half-rounds. Half-rounds are formed by splitting short lengths of pole down the middle. The half-rounds are nailed all around the edges of the framework, as shown in the pictures. They will extend from the top of the slats to about an inch below the framework. Be sure that the half-rounds are all of the same length, and fit them into place as carefully as possible.

If you wish, you may paint the bench any suitable color. This process, of course, quite conceals the natural color of the wood. For this reason many people prefer a clear varnish, applied with a brush. You can then easily make out not only the natural color but the original grain of the wood in all its details. A finish of this sort will be more in keeping also with the rugged, unfinished appearance of the rustic bench.



3. Rustic bench as seen from above.



4. Framework of bench.

ANSWERS TO THE PUZZLE ON PAGE 4268

HERE are the mistakes: (1) There is no name on the bow. (2) The portholes should open inward. (3) The scupper is opened the wrong way. (4) The numbers along the bow should read upward. (5) The foremast and (6) the funnels should lean backward. (7) No ship in dock uses anchor. (8) Hawsehole set wrong way. (9) Ratlines unfinished. (10) No ventilators.

A MAGIC TRICK WITH NUTS

THIS is an effective trick. First, we show the spectators a plate and a pocket handkerchief, inviting anybody who so desires to step up and inspect these articles. When the audience is convinced that the plate and handkerchiefs have no secret openings, we place the plate on the table and spread the handkerchief over it. Then we raise the handkerchief and shake out a number of nuts upon the plate. The audience is amazed.

Here is the explanation of the trick. We first make a triangular bag. We cut out two triangles of linen of the same dimensions and then we sew them together by two of the sides, leaving an opening. In the hem of each side of the opening we sew a piece of watch-spring. The two springs will keep the bag closed unless force is used. A pin, bent in the form of a hook, is now put through the corner opposite the opening.

Nuts are now placed in the bag, which we hang by the hooked pin on the side of the table that is away from the spectators (they must know nothing of this). The springs keep the mouth of the bag closed, so that the nuts will not fall out.

We then place the plate on the table near the edge where the bag is suspended. Spreading the handkerchief over the plate, we cause part of it to hang over the edge of the table where the hooked pin is. In picking up the handkerchief we also pick up the bag, hiding this from the audience.

The rest of the trick is simple. We shake the handkerchief with a few vigorous jerks. The springs at the bottom of the bag are not very stiff, and as the nuts are dashed against them with great force, the springs open and allow the nuts to fall out. The performer then lets the bag drop behind the table. To prevent the audience from seeing this, the table should be covered with a tablecloth reaching down to the floor.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 4495.

The locust tree, or false acacia, and its flowers and a leaf.

THE BEAUTY TREES

ALL of you know how beautiful trees are and how much they add to a landscape. Here we shall describe some of the more familiar of the trees grown in parks and gardens for the beauty of their form or foliage or blossom. And it must always be remembered that some of our common fruit trees in blossom are quite as beautiful as many of the trees which are grown because of their flowers. No laburnum or lilac can ever look more beautiful than an apple or a plum or a quince tree in full blossom.

Many of the trees prized for timber are exceedingly beautiful, and might well find a place here. The stately grandeur of the elm, the dainty loveliness of the birch, and the drooping gracefulness of the willow would give them a high place among trees for beauty, to say nothing of the maples.

Perhaps pride of place must be given to the Horse-chestnut. A single tree growing where it has plenty of light and air around it, with free scope to develop as it will, becomes a very lovely object, "in all the richness of its heavy velvet drapery, embroidered over with millions of silver flowers." Massed together the foliage and blossoms of the horse-chestnut are very striking, and they are quite as interesting when examined closely. The true horse-chestnut is a native of the mountains of Greece, Persia and India, but it has grown wild in America for a long time, and we may certainly reckon it among our wild trees. It grows fifty or sixty feet high, with an erect trunk. Unless it is too much crowded, it develops into a stately and symmetrical pyramid. If we look at the tree in winter, when the leaves are gone, we shall be struck by the strength and massiveness of the branches. This is a clear indication that they are intended to bear a heavy mass of leaves and blossom. The buds, even in January, are very large, and, as spring approaches and the sun becomes stronger, the buds suddenly burst, and the delicate green leaves seem to open out as if by magic.

There is no better plant in which to study the unfolding of the leaves than the horse-chestnut. We can easily see the overlapping scales in any bud at the end of a shoot; and if we carefully remove these one after another, we shall see how they are seated in the bud. Care is needed for this, as the bud is sticky. A gummy substance helps to hold the scales together and keep out water. When the brown scales are removed, we find thin chaff-like ones, and then come scales covered with woolly hairs, green in color and shaped like miniature leaves. The long woolly hairs are folded round like a scarf, and prevent too much loss of

water from the tender leaves when the buds open in the spring. If we cut a bud clean through the centre we shall see how closely all the scales fit together. They become smaller and smaller nearer the centre, where the tender end of the stem is. On the sides of the shoots are several large buds, which, if examined, often prove to be the same inside as the terminal bud which we have already opened. Some buds contain leaves and flowers; others (the smaller ones) contain only leaves.

The flower-buds are just as wonderfully packed. A German naturalist took a bud the size of a pea from a horse-chestnut, and found that the external covering consisted of seventeen scales well cemented together by the gummy substance. Then came the down, or woolly hairs, and inside four leaves surrounding a spike of flowers. With the aid of a microscope he counted sixty-eight flowers, and was able to distinguish the pollen.

THE COMMON ERROR ABOUT TWO CHESTNUT TREES

After they have opened, leaves and flower-buds continue to grow, and by the end of May, if the weather is favorable, the tree stands forth in all its glory. No wonder that where large numbers of horse-chestnuts are found growing together people go in thousands to see them when they are in bloom. The leaf is very large and is broken up into leaflets, each large enough to be a leaf on its own account.

There is a smaller horse-chestnut which is a native of Western North America. Its flowers are sometimes tinged with pink. Hardly less beautiful than the horse-chestnuts are the closely related Buckeyes. There are several American species. The flowers may be white, yellow, purplish or red, and they make a fine show on the lawn. None of these trees is related to the true chestnut. That belongs to the Oak Family, while the trees we have mentioned are related to the maples.

There are five trees all belonging to the *Pyrus* branch of the Rose Family, which are very beautiful when in blossom; and, while some of them produce fruit which, in its cultivated form, is much in demand, others bear berries that render the trees valuable from an ornamental point of view. One of the most striking of these is the Mountain Ash, Rowan, which, picturesque and attractive when in blossom, is a blaze of glory when covered with its clusters of bright red berries. It is in autumn that, as Wordsworth said,

> She lifts her head,
> Decked with autumn berries that outshine
> Spring's richest blossoms. . . . The pool
> Glows at her feet, and all the gloomy rocks
> Are brightened round her.

HOW THE BIRDS PLANT THE SEEDS OF THE MOUNTAIN ASH

Though so distinct in appearance, the fruits in structure closely resemble the apple and the pear; and birds like the thrush and blackbird are very fond of them. They soon strip the tree; but the seeds are not wasted, for, after eating the fleshy parts of the fruits, the birds drop the seeds and so plant them over a wide area. The cream-colored flowers are remarkably like those of the hawthorn, and have a similar fragrance.

While the mountain ash grows into a respectable tree in suburban gardens and bears well there, it is in its native state that it reaches perfection. It is found wild throughout Europe and in the north of Asia and America. In the western parts of Scotland it reaches a height of forty or fifty feet, with a straight trunk covered with smooth gray bark.

The tree is often called the Fowler's Service Tree, and its botanical name, *aucuparia,* is from the Latin word for "fowler" —bird-catchers in France and Germany bait their traps with rowan berries as a sure lure for thrushes and fieldfares.

THE WHITEBEAM TIMBER USED FOR MAKING COGWHEELS

The rowan's near relative, the Whitebeam, has flowers and fruit that resemble those of the mountain ash. It looks different, however, for its leaves are egg-shaped, with saw-like edges, while the rowan's are feather-like, with from thirteen to seventeen leaflets. The fruits are like Siberian crabs in shape, and are pale red in color. Like the rowan berries, they are used as bait by bird-catchers. In some place they are called chess apples. The whitebeam is by no means so common as the mountain ash. The timber is hard and is often used for making cogwheels.

The Wild Service Tree is very much like the whitebeam, but the dark glossy leaves, which at times grow four inches long and three inches broad, are lobed something like the maples, and the fruits are greenish brown when ripe. These

fruits, which grow in clusters and are very abundant on the tree, have a rough, acid flavor. When mellowed by frost or when overripe, they are agreeable, and are sometimes eaten. Though the wild service tree rarely attains a great size, it sometimes reaches a height of fifty-four feet, with a trunk eleven feet round.

The Wild Apple, or Crab, as it is often called, is probably the ancestor of all the splendid apples grown to-day. Its small sour fruit has given us the word "crab-bed," to describe a disposition that is anything but sweet and attractive. The blossom is beautiful, and no flower has more daintily colored or more delicate petals. They vary from white to rose-red, and a wild apple tree in blossom in May is one of the loveliest sights to be seen in the countryside. Even in autumn, when the crabapples, yellow and red, hang on their slender stalks, the tree is very attractive. The fruits, eaten raw, are harsh and acid, but a delicious jelly can be made from them, and they are greatly prized when pickled whole.

THE DIFFERENCE BETWEEN THE WILD PEAR AND WILD APPLE TREES

The Wild Pear tree can always be distinguished from the wild apple, even in winter, because it has the shape of a pyramid, whereas the crab tree is rounded. It may grow fifty or sixty feet high, but the wild apple rarely exceeds twenty or thirty feet. The apple branches, too, are far more crooked than the pear's. The wild pear is not so common as the crab. Its fruit is not edible, but all the splendid varieties of pears which we eat raw or preserve in syrup are derived and developed from this wild species. The flowers are white without the rose markings of the apple, and are less beautiful. They grow in clusters of five each, and measure an inch or more across. The wood of the pear tree, dyed black, provides a close imitation of ebony, and is often used for picture frames.

Another branch of the Rose Family includes the Wild Cherry and the Blackthorn, or Sloe; and in still another branch is the Hawthorn, or May. The European Wild Cherry, often called the Gean in England, is sometimes grown in our parks. It is a tree twenty or thirty feet high, with smooth bark and drooping pointed leaves that are downy on the under-surface. In favorable soil the gean may reach forty feet, and it is then a very beautiful tree, for in spring its clusters of white blossoms clothe it as with a mantle, and in autumn the leaves turn a bright crimson. Directly it ripens the fruit is greedily devoured by the birds.

THE WILD CHERRIES FROM WHICH OUR GARDEN FRUITS HAVE COME

There are several other species of wild cherry. One—the dwarf, or red, cherry is a shrub rarely more than eight feet high, and the other—the bird cherry, is a small tree ten or twenty feet high. The Japanese cherry has been introduced and grows well in some places. Cherry wood is fine-grained and red in color, and is much used by cabinetmakers and for musical instruments. All our cultivated varieties of cherries are derived from wild species. The gean, it is believed, gave us the red-fruited kinds and the dwarf cherry gave us the black-hearts. The cherry seems to be a favorite tree of the woodpecker, which may often be heard perforating the trunk in search of the larvæ of insects hiding under the bark.

The Blackthorn, which bears sloes, is generally seen as a hedgerow shrub, but if left alone and not trimmed down, it will grow into a small tree twelve or eighteen feet high. It gets the name blackthorn in contrast to whitethorn, another name for hawthorn, not on account of any difference in the color of its flowers, but because its branches are covered with blackish bark, while those of the hawthorn have a much lighter color.

The blackthorn flowers at the end of March or the beginning of April, often before its leaves have appeared, and it is one mass of blossom just when the hawthorn is only beginning to unfold its leaves. Unlike the hawthorn's, however, the blackthorn's flowers have no scent.

THE SLOE OF THE BLACKTHORN WHICH HAS GIVEN MANY LUSCIOUS PLUMS

The fruit, which is something like a small damson, is purplish black. When ripe it is covered with a beautiful bloom which, like all blooms, is one of Nature's protections for the fruit. Sloes are far too harsh to eat raw, but some people gather them to make a beverage. In France the unripe fruit is sometimes pickled and used as a substitute for olives. It is remarkable to think that from this harsh and unattractive fruit there may have been developed all the luscious varieties of plums that we enjoy to-day. An excellent ink for marking linen is made

from sloe juice by adding a little sulphate of iron to give permanence. The dried leaves of the blackthorn have often been used for adulterating tea.

Like the blackthorn, the Hawthorn, or Whitethorn, is a member of the Rose Family, and is more generally seen as a hedgerow shrub than a tree. Nevertheless, if allowed to grow freely in suitable soil and surroundings, the hawthorn becomes a tree forty feet high, with a trunk girth of anything up to ten feet. It makes a splendid plant for a hedge. Its numerous branches and network of twigs grow so densely that nothing can pass it. Indeed, the name hawthorn is derived from the Anglo-Saxon *haga,* an inclosure. The thorns are the spines with which the plant is so well armed as to add to its usefulness as a hedge round an inclosure. The name for the well-known red fruits, haws, is derived from the name of the tree, and not vice versa, as is generally the case.

THE FRAGRANT HAWTHORN, MUCH PRAISED BY THE POETS

The hawthorn is very common in America. Its flowers, fruits and leaves all make it easy to identify. The leaves, which appear before the blossoms, are lobed, and vary very much in size and in the extent to which they are divided. It is the fragrant blossom—the May, as it is called, from the month in which it generally appears—that makes the hawthorn one of our favorite wild plants and the best of all hedgerow trees. Poets have sung its praises since poetry was written.

The crimson berries that succeed the flowers are so numerous at times as to give the impression of a crimson cloth. They are eaten as food in times of scarcity, in some lands, and peasants make from them a fermented drink. Old books refer to them as "good food for hogs," and we are told, "the swineherds do beat them down for them."

Sometimes when the hawthorn grows on a clay soil its blossoms are tinged with pink, and occasionally they are red. The Red May of our gardens is a variety derived from these wild plants. The fruit, too, like the blossom, varies from time to time, being sometimes woolly and sometimes yellow in color. Birds love the fruits, and many insects find food and hospitality on the leaves, including the larvæ of the brimstone moth, the black-veined white butterfly and the lackey moth. The scent of the hawthorn seems to be particularly attractive to flies, which may generally be seen dancing round the tree on a sunny day. Honey is found in hawthorn flowers partly concealed by hairs, and the flower is generally pollinated by insects that visit the blossoms for the honey. But, in the absence of insect visitors hawthorn flowers pollinate themselves.

HOW SHAKESPEARE MADE A POPGUN FROM AN ELDER BRANCH

Another familiar hedgerow tree is the Elder, a member of the Honeysuckle Family; but, like the hawthorn and blackthorn, it is more often seen as a large shrub than a tree. However, it may grow to a height of twenty feet, and as it grows very rapidly, it is often planted in new hedges that are wanted to develop quickly. It throws out juicy shoots that very quickly toughen into wooden tubes with pith inside, and boys like to make peashooters and popguns out of elder branches by removing the pith. Shakespeare had evidently done this in his boyhood, for he speaks of "a perilous shot, out of an elder gun." The ancient Greeks made musical pipes from the elder wood.

The leaf, which is of the feathered kind, is divided into five, seven or nine oval leaflets, with toothed edges, and occasionally we find a curious variation, the leaflet being cut into irregular segments. This, however, is probably an escape from a garden of a cultivated variety of elder. The clusters of creamy white flowers appear in June and possess an odor that some people find objectionable.

The flowers are succeeded by a profusion of deep purple berries, and these are really compound drupes, or stone-fruits with several stones, each containing a seed. From time immemorial these have been gathered by country people to make elderberry wine. As a medicinal plant the elder used to be in great demand, and every part of the plant—root, bark, leaves, flowers and berries—has been used for some healing purpose.

THE HANDSOME HOLLY WHICH MAY GROW INTO A TALL TREE

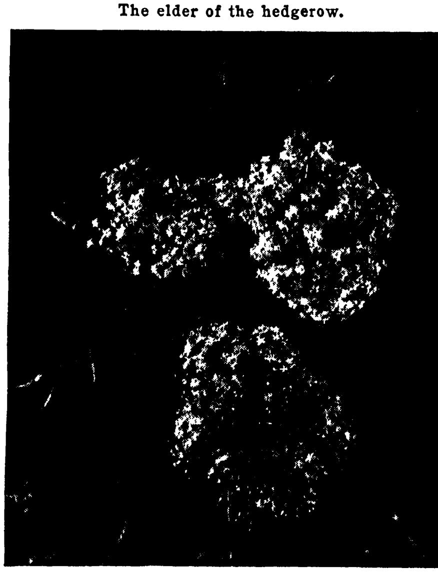
Certainly one of the most distinctive of our ornamental trees, and one of the handsomest in a sombre way, is the Holly. The European holly cannot stand very cold weather but is widely grown in the United States. The American holly resembles it closely. Generally the holly is

seen as a bush kept down by clipping, but it may grow into a tree forty or fifty feet high. In Surrey, England, there is one eighty feet high, and in the New Forest there are holly trees whose trunks are eight or nine feet round. Hollies were probably more common in England in olden times than they are to-day, and the plant has given its older name of *holm* to places such as Holme, Holmhurst, and so on.

Evelyn, the diarist, was very proud of the holly hedge at his home, Sayes Court, on the banks of the Thames, where Peter the Great stayed for a time during his sojourn in England, and, barbarian as he was, ruined the beautiful gardens. "Is there under heaven," writes Evelyn, "a more glorious and refreshing object of the kind than an impregnable hedge of about four hundred feet in length, nine feet high, and five in diameter which I can show in my now ruined garden at Sayes Court (thanks to the Czar of Muscovy) at any time of the year, with its armed and varnished leaves, the taller standards at orderly distance, blushing with their natural coral? It mocks the rudest assaults of the weather, beasts, or hedge-breakers."

In shape the holly tree is a pyramid, and it thrives particularly well on a sandy soil. The trunk is covered with smooth bark, pale gray in color, and from it is made the sticky bird-lime which bird-catchers use to entangle the feet of young birds. No other tree has its foliage so well protected against would-be foes. Grazing animals are kept off by the sharp, formidable spines that project at all angles, and it is a remarkable fact that, though when the holly is a low bush all its leaves are protected in this way, when it grows into a tall tree the upper leaves are generally smooth-margined.

The elder of the hedgerow.



The elder blossom.

The flowers of the holly are small and inconspicuous individually, but as they are white and grow together in clusters, they make a good show on the bush in May and June, and even later. Staminate and pistillate flowers often appear on the same tree, but there are many hollies that bear flowers of only one kind, and this explains why a tree which is loaded with blossoms summer after summer often produces no berries. Its flowers are all staminate.

The berry, or fruit, is like that of the elder—a drupe, or stone fruit, of the compound form—that is, instead of having only one stone and seed inside the fleshy part, like a plum or cherry, it has four little stones, each with its seed. The berries ripen in September, when they become bright red and very glossy, and the holly tree then looks its best. If other berries are abundant the holly may retain its berries all through the winter, for they are hard and unpalatable to small birds,

which eat them only when other foods fail. Blackbirds, however, like them.

The wood of the holly tree is very hard and of fine texture, and, as it is almost as white as ivory and takes a fine polish, it is in great demand by cabinetmakers for veneering and inlaying. It is often used as a substitute for boxwood and, when dyed black, for ebony.

THE BEAUTIFUL LABURNUM WHICH THRIVES IN ALMOST ANY SOIL

Several beautiful trees that belong to the Pea Family are grown not only in our gardens but are sometimes found wild. The first of these is an escape from gardens, and the seed came from some tree growing in cultivated ground close by. The tree we mean is the Laburnum. Since it produces an abundance of seeds arranged in pods and thrives in almost any soil, it may seem curious that it is not found wild far more often. One explanation is that rabbits are so fond of the bark of young laburnum trees that they destroy many of them.

The laburnum is a native of Central Europe, but has been long grown in America. Generally it does not grow more than twenty feet high, but specimens of thirty feet are by no means uncommon. The spreading branches bend over and droop very gracefully at their tips, and the tree has the appearance of a playing fountain. The bark, in the early years of the tree, remains quite smooth, but later it furrows transversely, and pieces come off the trunk. The leaf has a long stalk and carries three pointed leaflets. The most characteristic thing about the laburnum is the blossom, which, from its graceful drooping form, has been variously named golden rain, golden chains and golden earrings.

THE FLOWERS OF THE LABURNUM AND THE DANGER THAT LIES IN THEM

The flower-stalk projects from the branch horizontally and bears a wealth of brilliant yellow flowers, described by the poet Cowper as "rich in streaming gold." These develop into long downy pods containing many seeds, which should never be eaten, for they are extremely poisonous. The pods hang on the tree generally till the next season's blossom has appeared. Laburnum wood is used a good deal by musical-instrument makers and by turners.

The other member of the Leguminous, or Pea, Family referred to is the Locust tree, or False Acacia, as it is sometimes called because of its resemblance to its relative, the acacia. The locust tree is a native of North America, and was introduced into Europe at the beginning of the seventeenth century. It is a graceful tree which grows rapidly in the first ten years of its life, often attaining a height of forty feet, and then it grows far more slowly. The leaves are very feathery, being divided into a large number of small oval leaflets. The flowers are remarkably like those of the laburnum, but larger, and white or flesh-colored. They have a sweet scent.

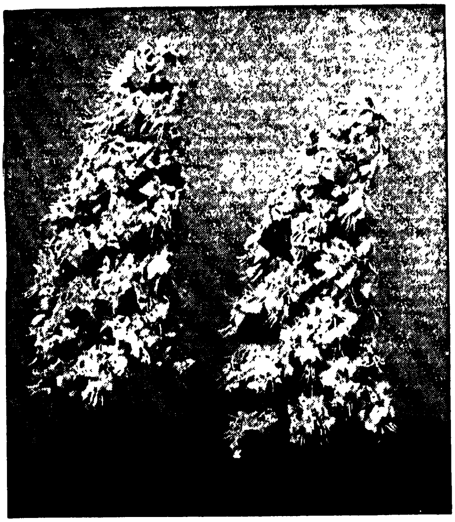
There is another member of this family which makes a brave show in the woods or when transferred to the lawn. This is the Redbud, or Judas Tree (*Cercis canadensis*), found growing in North America from Canada to Florida and Texas. The reddish purple flowers appear before the leaves, about the same time as the early violets. The leaves are heart-shaped, and the green pods turn to purple in the late summer. The European Judas Tree, from which the American was named, is not the same, though it is a relative.

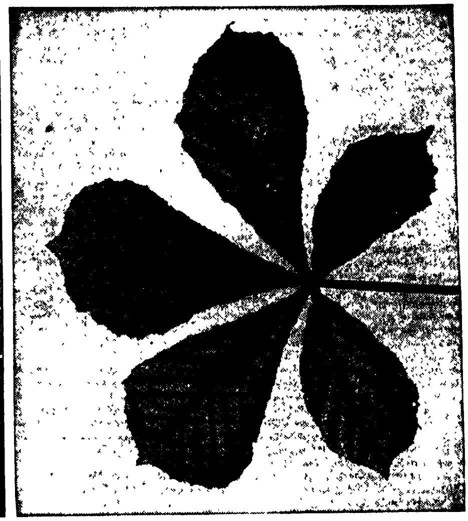
In the United States the magnolias are among the most prized of Southern ornamental trees. There are nine or ten species, all beautiful. The Laurel Magnolia is one of the most beautiful trees in the world. Its white waxy flowers are sometimes eight inches across. Attempts to grow it in the North are not very successful. Another magnolia, the Cucumber Tree, is much hardier, and can be easily grown where winters are not too severe. The flowers are yellowish green, and are half concealed among the leaves. The seed-cases resemble cucumbers and turn from green to pink to vivid red as they mature. When the case opens the scarlet seeds hang out.

One other tree grown for ornament may be mentioned here, and that is the Plane tree so often found lining the streets of cities and towns. It is particularly fitted for this, for, unlike most trees, it seems to thrive in a smoky atmosphere. The leaves and bark become coated with soot, but a shower cleans the leaves, and the old bark is thrown off in large flakes by the pressure of the new bark underneath. The plane usually grown is a variety of the common Oriental plane, with leaves less deeply divided.

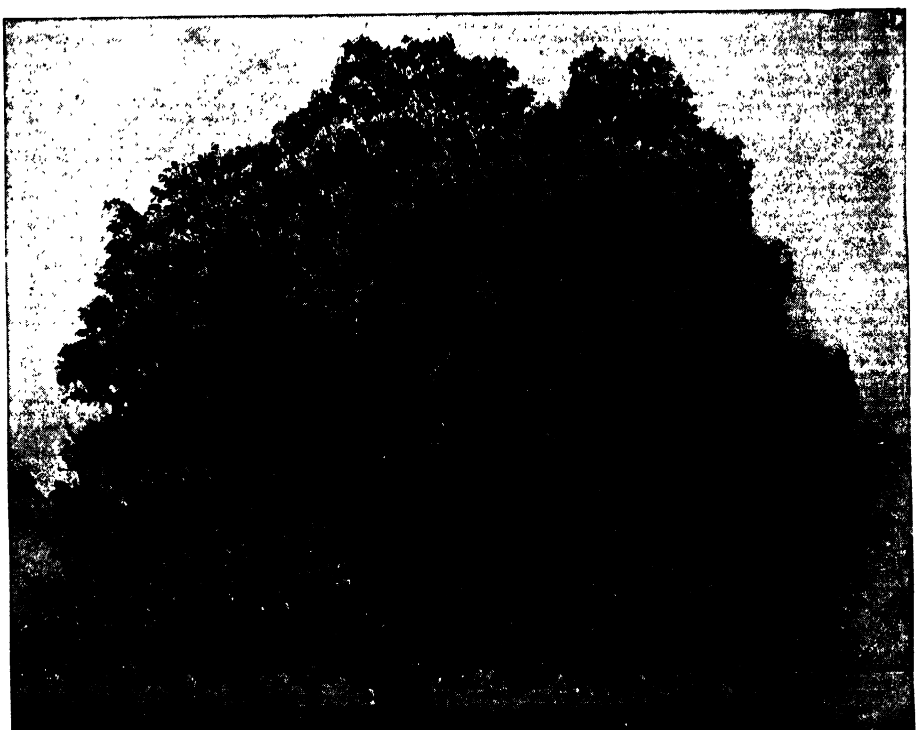
THE NEXT STORY OF PLANT LIFE IS ON PAGE 4434.

THE HORSE-CHESTNUT'S SILVER FLOWERS





There is no finer sight presented by Nature than a horse-chestnut tree in full bloom. The leaf of this tree is split up into seven leaflets, and these are so large that many people think that each separate leaflet is really a complete leaf. The five-fingered leaf shown above is of the buckeye.



The fruit of the horse-chestnut looks so much like that of the sweet chestnut that many people think it is a variety of that tree, but, as a matter of fact, the two trees belong to distinct families. Here we see a horse-chestnut "in all the richness of its heavy velvet drapery, embroidered over with millions of silver flowers." It came to us from Asia by way of Europe, but is closely related to our buckeye.

THE WILD APPLE TREE'S DAINTY BLOSSOM

The leaves of the wild apple tree vary very much in shape, as may be seen. They are smooth on the upper surface, but sometimes downy underneath.

Few flowers that grow on trees present a more beautiful sight than the clusters of wild apple blossoms, with petals delicately tinted with pink.

We all know the crab-apple tree, which is so beautiful in spring when it is covered with a mass of exquisitely beautiful pink blossoms, with a spicy fragrance. In some parts of the country cider is made from crab-apples, and the crab-apple jelly is a favorite delicacy.

THE HOLLY WITH THE PRICKLY LEAVES

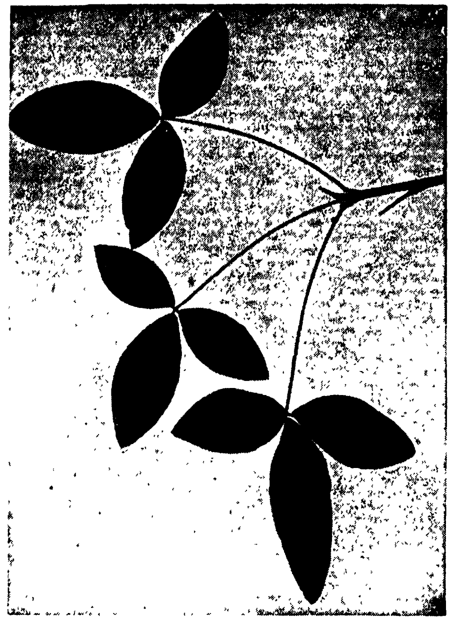
The leaves on the lower branches of the holly are prickly, but the leaves higher up are not.

The tiny white flowers of the holly grow in thick clusters. Later come the brilliant red berries.

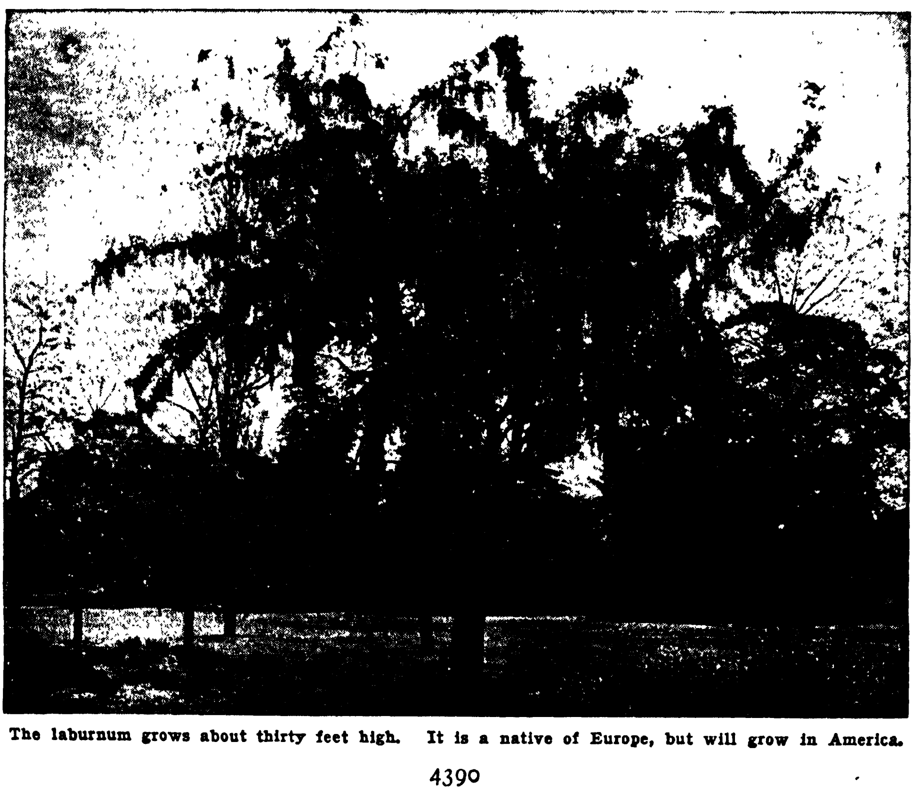
We know holly best as a bush, but it grows to a tree forty feet high. When covered with red berries, it is a great sight. This is a European holly tree, on which the berries grow in clusters.

THE LABURNUM'S GOLDEN EARRINGS

There is no prettier sight than the laburnum with its clusters of yellow flowers, like earrings.



Leaves and flowers appear in May, and the leaflets form in threes on long slender stalks.



The laburnum grows about thirty feet high. It is a native of Europe, but will grow in America.

THE WILD SERVICE TREE OF EUROPE

The flowers of the whitebeam are remarkably like those of the wild service tree; in fact, the one blossom is often mistaken for the other. The leaves of the two trees, however, are different.

The wild service tree is very common in Europe. Though ornamental, it does not often grow very high. The greenish brown berries are sold in fruiterers' shops, for, though rough and acid when fresh, they are pleasing when mellowed by frost. Our service-berry or shadbush is quite different.

THE BLACKTHORN THAT GIVES US SLOES

The white blossoms of the blackthorn produce sloe berries, used for adulterating cheap wines. Years ago, when tea was dear, old country people made tea from blackthorn leaves.

Blackthorn is called by this name not because its flowers are darker than those of the whitethorn, or hawthorn, for they are whiter, but because the bark is nearly black. Probably our plums are descended from this tree. In Europe the wood is much valued, as it is hard and takes a fine polish. The famous Irish blackthorn stick is made from the knobby stems, peeled and polished.

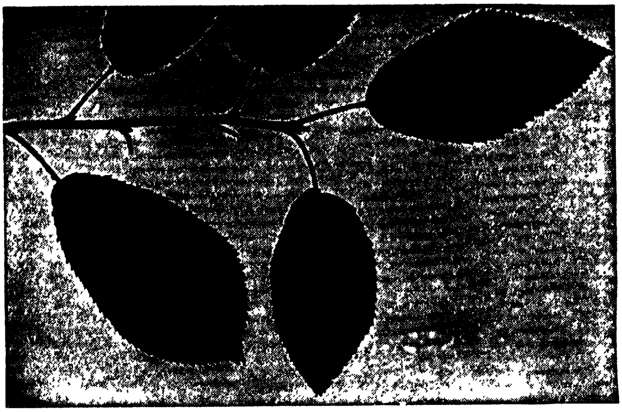
THE HAWTHORN'S FRAGRANT BLOSSOM

Hawthorn rarely grows larger than a bush in places where cattle have access, because the animals are fond of the leaves and young shoots.

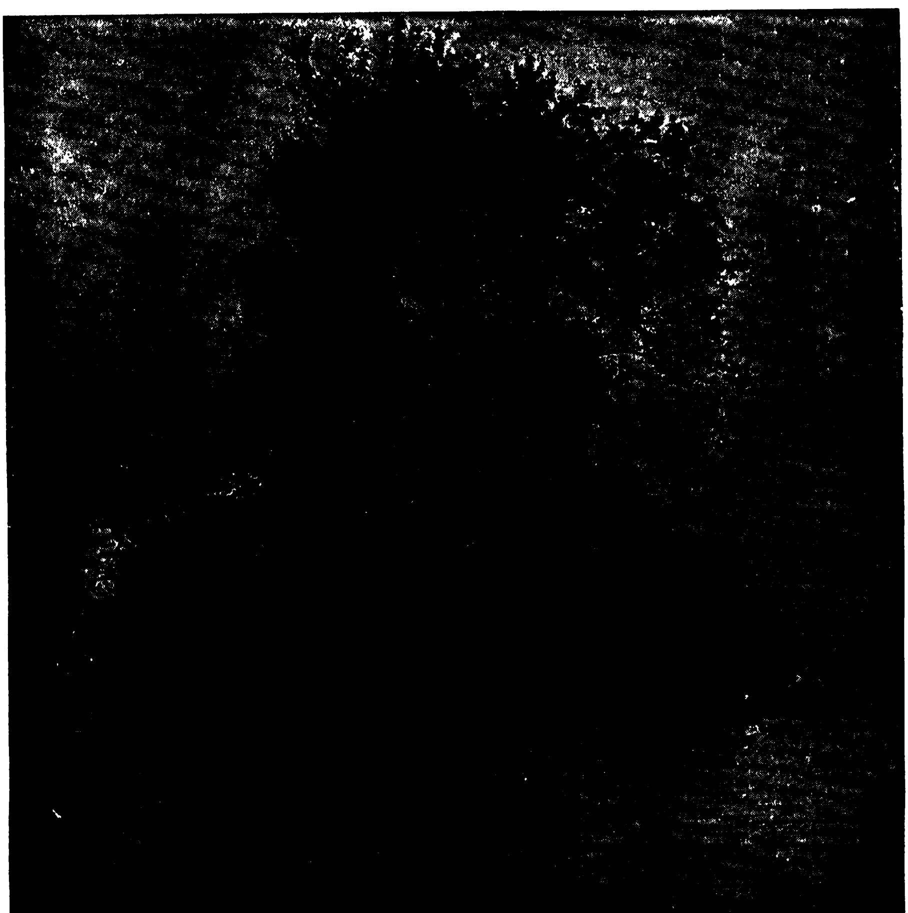
The hawthorn is the fragrant blossom which poets call the "may." It is usually white, though sometimes it will be found tinged with pink.

This is the famous English hawthorn, the "may" of the poets. Unlike our hawthorns, the odor of its flowers is exquisitely sweet. It has been introduced into this country and is prized, not only for its sweetness, but for the wild beauty and grace of the tree. In Europe it is often used for hedges.

THE WILD CHERRY OF THE COUNTRYSIDE

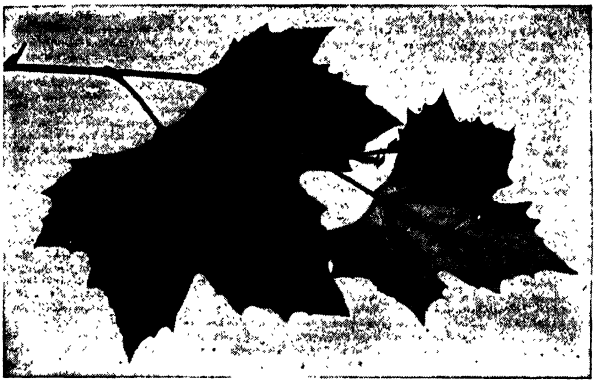


The leaves of the wild cherry are deep blue-green in color, and grow on slender branches. When the tree is in bloom it is covered with delicate cup-shaped flowers, which later produce myriads of cherries.



This is a fine specimen of the wild cherry tree, from which our luscious orchard cherries are descended.

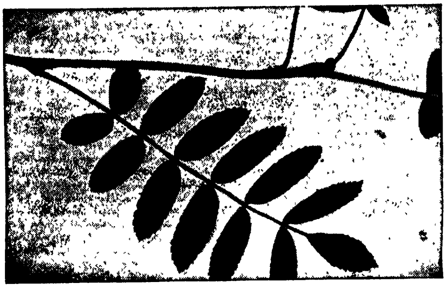
THE PLANE TREE OF CITY AND TOWN



The broad leaves of the plane give the tree its name, for "plane" means "broad." The leaves are like those of the maple, but the trees are not related. The flowers grow in balls like old-fashioned buttons.

The plane is the most long-suffering of trees, for smoke and dirt seem not to affect it. Even when the bark and leaves are covered with soot the tree flourishes, and this is why it is so useful for planting in city streets. The plane trees shown in this picture came from Asia by way of Europe.

THE ROWAN, A TREE OF ANCIENT MAGIC



Called mountain ash from the shape of its leaves, the tree really belongs to the apple family.

After the white flowers will come scarlet berries, once thought magic charms against evil.

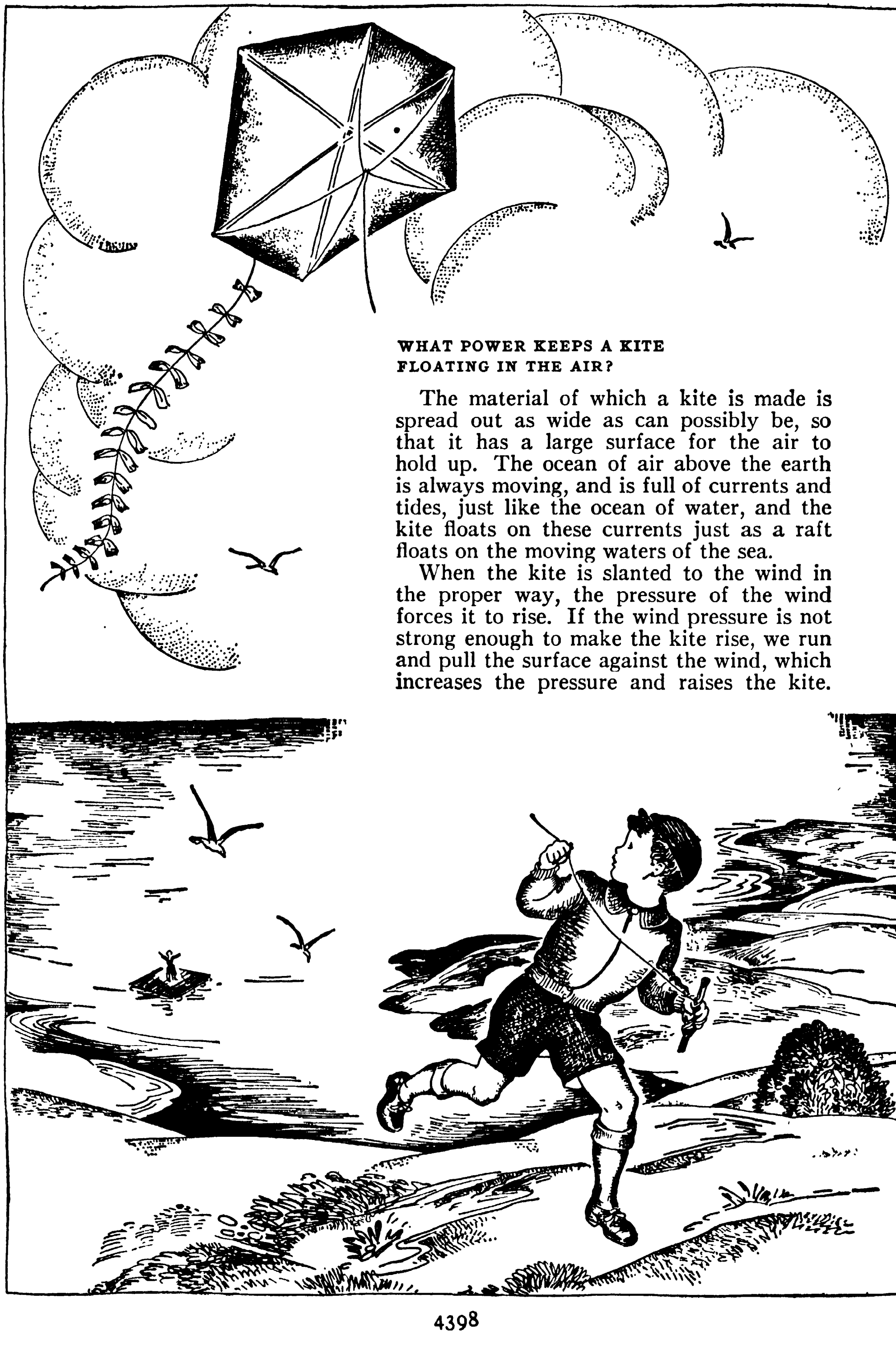
The mountain ash will grow almost anywhere in the poorest soil. Its other name, rowan, means "charm." We find our native rowan on hillsides and in rocky woods, while the tree we so often see in parks is generally the European rowan. The tree in full bloom is a charming picture.

Why Doesn't the Water Fall Out of a Pail When We Swing It Around?

WE must remember that every substance, whether solid or liquid, tends to remain in the same position unless some force is applied to move it. The force of gravity keeps the water in the bucket or pail when the bucket is at rest, and attracts both the bucket and the water to the earth. When we swing the bucket over our heads, gravity would cause the water to fall out if we held the bucket still, or moved it only slowly, but by keeping it moving quickly we bring other forces into play that act in other directions. One of these forces is called centrifugal action, which means the act of flying from the center. The water presses away from the center of the pail, and against the sides.

If the water could get out, it would not fall straight down to the earth, but would go on some distance in the direction in which the bucket was moving at the time.

So, then, the water stays in the bucket as the result of the several different forces.



WHAT POWER KEEPS A KITE FLOATING IN THE AIR?

The material of which a kite is made is spread out as wide as can possibly be, so that it has a large surface for the air to hold up. The ocean of air above the earth is always moving, and is full of currents and tides, just like the ocean of water, and the kite floats on these currents just as a raft floats on the moving waters of the sea.

When the kite is slanted to the wind in the proper way, the pressure of the wind forces it to rise. If the wind pressure is not strong enough to make the kite rise, we run and pull the surface against the wind, which increases the pressure and raises the kite.

WHY DOES GRAVITATION NOT PULL DOWN BODIES LIGHTER THAN AIR?

Gravitation does pull down bodies lighter than air; it is a universal law that applies as much to particles too small and light to be weighed, as to gigantic suns. It is true that a fluff of thistledown will float away in the air as if it were unaffected by gravitation. Particles may fly across to us from the sun in spite of the enormous gravitational pull exerted by the sun. Light gases mount in the atmosphere and may fly away into space. All these things are true, but gravitation, nevertheless, is acting on all these bodies.

The thistledown floats away simply because the warm air ascending carries the down with it; but both the air and the down are being pulled by gravity. We have no more right to say that the thistledown and the air are not pulled down by gravity than we have to say that we are not pulled down by gravity during the time we jump into the air; or that a bullet is not pulled down by gravity while it is ascending. In each case gravity is pulling down, even though a stronger force is pulling or pushing harder in the other direction. In the case of the thistledown, the force opposing gravitation is the hot air. In the case of the hot air, it is the molecular force of its molecules. In the case of the particles flying from the sun, it is light pressure. In the case of a jumping man, it is his muscular force. In the case of the bullet, it is the expanding force of the explosive in the gun. But in each case gravitation is acting, and never ceases to act.

IF A FEATHER IS LIGHTER THAN AIR WHY DOES IT EVER SETTLE?

If a feather were really lighter than air it never would settle. Since a feather in time *does* fall to the ground, it must be heavier than air, whatever we may think at first. If we were to take all the matter composing a feather and put it together again in a tight lump, it would drop at once. The business of the feather is to serve the life of a creature that flies, and therefore nature has made it as light as possible. It is made so that it will itself hold air, and is spread out in such a way as to take the utmost possible advantage of the supporting power of the air. Yet, like many other things that the air will support for a time, the feather is heavier than air, and therefore if the air is still, the feather must fall. It falls under the force of gravitation. If the air, however, is thrown into motion by the wind, the motion endows it with a force that may be greater than the earth's gravitational pull upon the feather, and so the feather may be lifted from the ground into the air. It is all a question of the balance between one force and another.

WHAT KEEPS A SHELL FROM FALLING TO THE GROUND?

Not only does the shell not fall to the ground at once when fired, but it always travels in a curve of a certain kind. All things travel along paths of this particular kind when they are thrown forward.

The path taken is the result of the working together of all the forces that act on, or in, the shell. If the shell were simply allowed to roll from the mouth of the gun, it would fall to the ground at once, for the only force then acting upon it to any extent would be the steady pull of the earth.

But when the shell is fired from the gun, it leaves the gun in a certain direction and with a certain amount of force, and though Newton's law of gravitation says that the earth is pulling the shell, his first law of motion says that every moving thing tends to move on in the same straight line at the same speed forever.

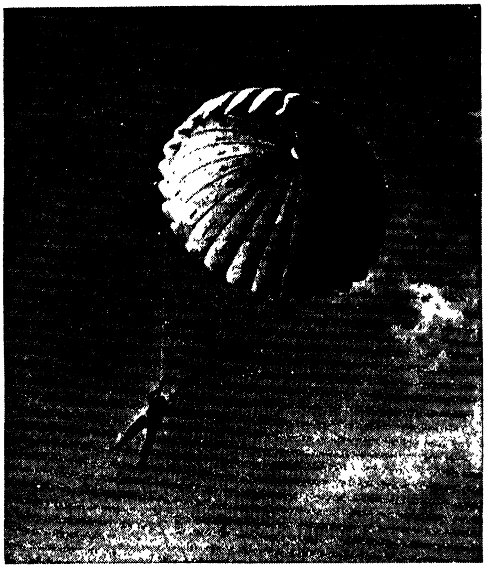
The actual path of the shell is the result of the acting together of several forces. Sooner or later gravity gets the upper hand, especially as the resistance of the air helps it.

DO THINGS WEIGH HEAVIER OR LIGHTER WHEN HOT OR COLD?

This question about gravitation is really extremely interesting and it is one on which many remarkable experiments have been made.

The answer is that the power of gravitation is not in the slightest degree affected by temperature; in other words, the same thing —if nothing is taken from it or added to it— weighs just the same whether it is hot or cold.

There is another point to consider, however. When a thing is heated it swells, as a rule, and though nothing has been added to it, it is occupying more space, so it is made lighter in proportion to the space it occupies. Thus hot water will float on the top of cold water; hot air will rise in cold air, and so on. This, however, is not a question of absolute weight, but of the relation between that weight, which is not changed, and the volume of the thing. The total weight of the thing is not changed by a change in temperature. So the answer to the question is that an object weighs the same regardless of whether or not it is hot or cold.



U. S. Army Signal Corps

WHAT IS A PARACHUTE AND HOW DOES IT WORK?

A parachute is rather like an enormous umbrella, with no handle, but with cords stretching from its rim down to a harness fastened to the parachute-jumper's body. A man who has on a parachute may jump from a plane thousands of feet in the air and land safely. When he starts to fall the parachute streams out above him, and the air through which it is being pulled causes it to open wide. Now as soon as this happens the parachute begins to fall more slowly. The air gets in under the big umbrella and presses upward against it. This upward pressure is strong enough to overcome some of the force that is pulling the man and his parachute down toward the earth, and so he falls slowly.

The parachute is carefully packed into its case by an expert, trained parachute-rigger. He knows that a flyer's life may depend on his skill. The jumper does not open it until he has fallen some distance below the plane. This is done so that the 'chute will not become tangled with the undercarriage of the plane. To open the 'chute, the jumper pulls the rip cord attached to the left shoulder strip of his harness. This pulls open the cover of the parachute and causes a spring to throw out a small parachute, about three feet in diameter. The small 'chute pulls out the big 'chute, which opens and fills with air.

Parachutes may be of different sizes, depending upon the weight of the jumper and the air conditions he expects to meet. A regulation twenty-four-foot parachute is made of sixty-eight square yards of unfinished silk. It is put together in twenty-four gores, or strips, like those of an umbrella. The strips grow narrower as they near the top, where there is a small round hole in the 'chute. This hole is to let some of the trapped air pass up through the 'chute and keep it from bobbing about like a toy balloon as it slowly floats downward to the earth.

The parachute cords come together at the bottom in two bunches, called risers. The jumper holds on to these and uses them to guide the 'chute, just as one uses the ropes of a rope-swing. Just before landing, the jumper must pull up on the risers in order to help break the shock of hitting the ground. He has to learn how to make a good landing just as the pilot of a plane does. While the jolt of landing is about the same as if one were jumping from a ten-foot wall, it is quite possible, if one is not careful, to get a sprained or broken ankle, or to get tangled up in the collapsed parachute.

HOW DOES A GYROSCOPE KEEP THINGS RIGHT SIDE UP?

The gyroscopic top appears to disregard the law of gravity. Does it really do so? No, the gyroscope acts, not in defiance of the earth's laws of gravity and rotation, but in obedience to them. As far back as 1852, the French scientist Jean Foucault demonstrated the rotation of the earth by the use of a gyroscope.

A gyroscope is a rapidly spinning, well-balanced wheel, supported so as to allow it three degrees of freedom. It is free to turn about (1) its spinning axis, (2) its vertical axis, and (3) its horizontal axis.

The gyro has two properties that make it useful to us. Set a gyro spinning. Pick it up by its base. Twist and turn the arm that holds it. Face north. Face south. Hold the base at an angle. Hold it upside down. As long as the wheel is spinning, the spinning axis will stay pointing in the same direction. This is called the gyro's rigidity in space, or gyroscopic inertia.

Set the gyro spinning again. Lightly press downward on one edge of the supporting ring. Instead of tipping under the finger's pressure, the gyro moves away in a direction at right angles to the finger pressure. This is called precession.

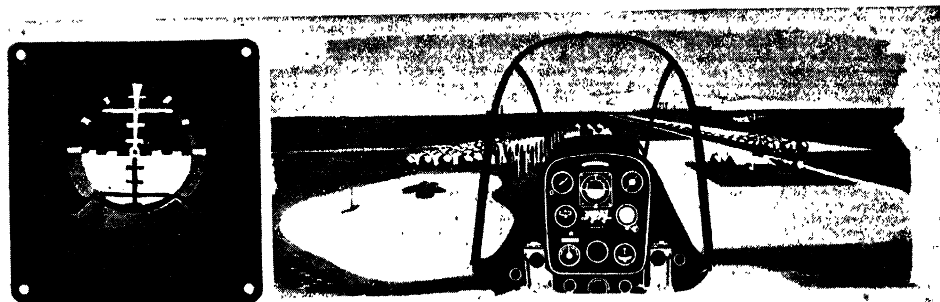
Not until 1910, when the gyrocompass was

first developed for naval vessels, was there any practical application of these two important properties of the gyroscope. It was used as a toy.

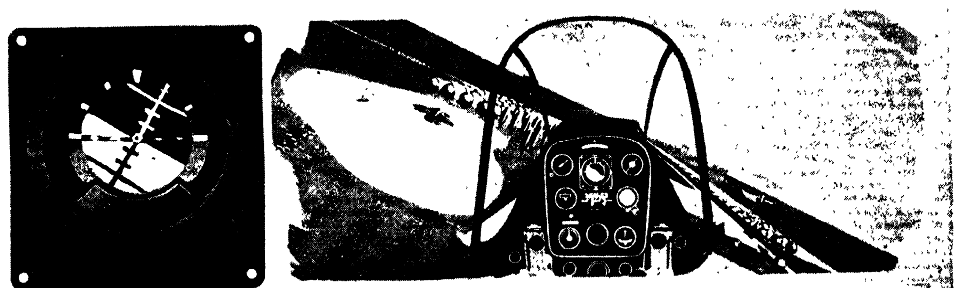
In the gyrocompass the spinning wheel is used to keep the ship on a true course. It is better than a magnetic compass, for it is not affected by the earth's magnetic field; its needle points to the true north, not to the magnetic north as the needle of the magnetic compass does. More wonderful still, the gyrocompass can be used with a mechanism called a gyro-pilot, which steers the ship more smoothly than any human pilot can.

Some ships have a gyroscopic stabilizer. This keeps the ship from rolling in rough seas. Submarines have gyro-controlled torpedoes. Some railroads use a gyro track recorder, which records all irregularities of the track traversed even when the train is apparently running quite smoothly at ordinary speed. This sensitive instrument "feels the bumps" and records them unerringly.

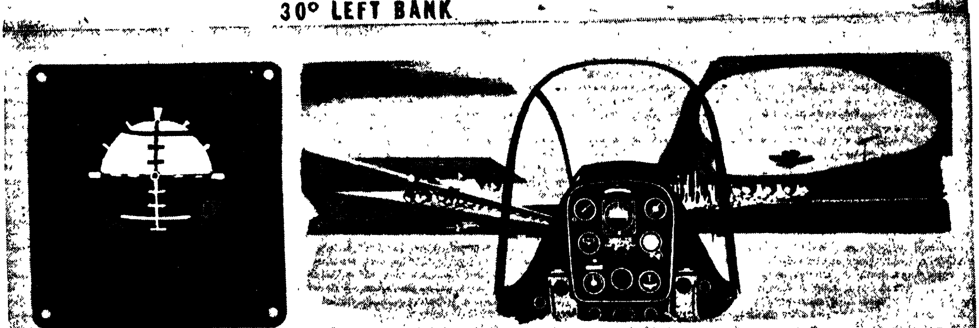
THE NEXT WONDER QUESTIONS ARE ON PAGE 4448.



LEVEL FLIGHT



30° LEFT BANK



INVERTED FLIGHT

The drawings of the instrument panel of a plane show its attitude, or position, in relation to the horizon. At the left is the "sensitive sphere" (the indicator) of an attitude gyro installed in the plane. The upper half of the sphere is dark in color (the sky); and the lower half is light (the land). Where these colors meet is the horizon. At bottom—inverted flight—the sphere shows that the plane is flying upside down.

Three Lions

Here we see fishing trawlers and fishing boats, with the fishermen hauling in a great catch off the Norway coast.

WEALTH FROM THE WATERS

WATER is such a common part of our daily life that we usually do not realize how important it is. We drink water and we use it to keep ourselves and our belongings clean. We play in the water and learn to swim, paddle a canoe, sail a boat and otherwise enjoy ourselves. But do we ever stop to inquire just how much water contributes to the riches of the world?

About three-quarters of the earth's surface is covered with salt water. In addition, we have all the springs, brooks, rivers, ponds and lakes which dot the surface of the earth; and still more water is stored below in underground streams. How does all this water help to supply man with the things he wants? Let us see how the waters of this earth provide food and drink, livelihood and wealth to many.

One of the very first products man obtained from the sea was salt. It not only gives flavor to food, but it is an essential part of all animal tissue. Millions of years ago much of the earth's surface lay under salt water. Where these seas receded, the salt was left behind and in time was covered with layers of soil and rock. Today much of the world's salt is mined from the salt beds which were left buried. There is more information on this important substance in the article A Grain of Salt.

From earliest times men living near oceans, lakes or rivers have obtained part of their food from the water. Fishing is responsible for many important developments. The first boats were used by fishermen; the earliest explorations were made by men sailing far away from land in search of fish; in Norway and Britain towns developed wherever herring appeared in large numbers; the naval strength of Great Britain, France and Spain grew from their fishing fleets; the settlement of Canada was influenced by the fishing in waters near Newfoundland and Canada.

Before World War II the world-wide commercial value of the fishing industry amounted to about $600,000,000 each year; and it has been growing rapidly. The fisheries of the United States and Alaska are valued at more than $200,000,000. Those of Canada are valued at close to $100,000,000. The fisheries of the Soviet Union, Great Britain and China amount to more than $50,000,000 each per year. Other countries whose fisheries come to millions of dollars each are: Japan, France, Italy, Spain, Germany, Norway, the Netherlands, Denmark, Sweden, Australia, Portugal, the Philippines and India. The

catches of greatest value are oysters, sea herring, cod and salmon.

Canada and the United States are particularly fortunate in their fishery resources. Indeed, fishery products rank fifth among the food resources of the United States. The waters in and around Canada and the United States teem with fish of many varieties, valuable for a number of uses. The fisheries extend along both coasts as well as through the Great Lakes and the large rivers. New England, around Gloucester and Boston, and the Grand Banks off the coast of Nova Scotia and Newfoundland are the chief centers.

The Grand Banks are shelves, or high places in the ocean floor; and so it is a comparatively quick and easy task to catch here those fish which stay near the bottom of the ocean. The fishing fleets remain until they have a full cargo. Cod is the main catch, but haddock, hake, halibut and mackerel are also brought in.

From the Middle Atlantic states, fishing fleets put out to sea and return with flounder, mackerel, bluefish, tunny and so on. Oysters, crabs, shrimps and scallops come from Long Island Sound and Delaware and Chesapeake bays. In the South Atlantic and Gulf States, the catch includes shad, sea mullet, red snappers, oysters, shrimps and sponges.

On the Pacific coast, the salmon fisheries of the United States and Alaska are the most valuable in the world. The United States also has the most valuable inland fishery in the world in the Great Lakes. Fresh-water fishing is important along the Mississippi River and the many streams that flow into it.

Not all of the huge annual catch is sold fresh. A great deal of the fish is canned or preserved in some way. The canning of salmon, sardines, tuna, shrimp, oysters and clams is an important part of the industry. Much of the herring, salmon and haddock brought in by the fishing fleets is smoked and dried to preserve it, and the cod and mackerel are salted or pickled. The fisheries also have important by-products such as cod-liver oil, whale oil, fertilizer and mother-of-pearl from oyster shells.

The fisheries of Canada are fifth in value in the world. They include salmon from British Columbia and lobsters from around Quebec and the three Maritime Provinces. Oysters from Prince Edward Island, New Brunswick and Nova Scotia are an important product. In proportion to the population of the island, the fisheries of Newfoundland are more valuable than those of any other country.

In Europe the fisheries of Great Britain and Ireland are the greatest. They resemble those of the United States in size and value. In Russia the greatest amount of fishing is done in the Caspian Sea and the Ural and Volga rivers. The value of the catch is exceptionally high, as this is where sturgeon is found. The salted eggs (roe) of the sturgeon are what is called caviar, one of Russia's most famous exports.

Philip Gendreau, N. Y.

Much of the earth's surface once lay under salt water. After the ocean had receded, salt deposits, often of great size, were left behind. Here women are carrying away salt from a large surface deposit in India.

Fishing is also important in the economic scheme of France. The fleets fish off the French coast, in the North Sea and in the waters around Newfoundland and Iceland. Norway has always been a land of fishermen. Cod is the main catch; and the production of cod-liver oil is important. The Lofoten Islands are the center of this business.

Fishing for oysters has become a world-wide enterprise. The largest single oyster-producing area is Chesapeake Bay. Other important oyster beds in the United States are found in Long Island Sound, other bays on the

Atlantic coast, the Gulf of Mexico, San Francisco Bay and along the coast of Washington and Oregon. Canadian oyster beds are found in the Gulf of St. Lawrence and off the coast of British Columbia. In Europe, England, Wales, France, Holland and Italy are important oyster-producing countries.

When rapid transportation and refrigerated cars made it possible to ship oysters long distances, there arose a great demand for them, and oyster "farms" were started. In suitable bays along the coast of the United States, France, Holland and Japan, young oysters are "planted." Before they are ready to be sold, they are "transplanted" to other waters where the food is better and they can be fattened up for the market. Most of the oyster beds in Long Island Sound have been developed in this manner.

Oysters furnish us with pearls and mother-of-pearl. Other valuable products of the sea are sponges and coral. We tell you the stories of pearls, sponges and coral in other articles in THE BOOK OF KNOWLEDGE (see Index).

Ben Schnall from Frederic Lewis

A fine oyster harvest waiting to be shipped. Oyster fishing is carried on in many parts of the world.

The plants that grow in the sea also have many uses. Certain kinds of seaweed are used for food in the Orient and in Hawaii. The Japanese have found these plants so important that they have developed huge seaweed farms. From kelp, a large seaweed, they manufacture a food called Kombu; and they also cultivate a red seaweed which they call Amanori. Agar, a seaweed found in Japanese and Pacific waters, is used to make gelatine, candy, pastry and ice cream; in canning fish, sizing cloth and clarifying wines; in the manufacture of paper; and as a dressing for some kinds of wounds. Scientists have found agar of great value in the study of bacteria, since many bacteria grow readily upon it.

Irish moss is a seaweed used by brewers in the manufacture of beer and it is also used for cough medicine. Some cooks use it in making that delicious dessert, blancmange. Dulse, found along the New England coast, is eaten as a vegetable in some places. Eel grass, which grows along the coasts of Mexico, Quebec, Nova Scotia, New Brunswick, Holland and France, is the favorite food of wild ducks. It is used for insulation, for stuffing upholstery and for soundproofing; and it has been used in the manufacture of paper. Some seaweeds are used as sources of iodine, potash and other chemicals.

Sea water contains minute particles of many minerals. One of these, bromine, is now being extracted from the sea in large quantities. There is a large bromine factory at Kure Beach, near Wilmington, North Carolina. Bromine is important in the manufacture of photographic plates and films, and of ethyl gas. Scientists estimate that there are about 2,300 million tons of gold and about the same amount of silver in the ocean. If they could discover a profitable method of extracting these metals from the sea, gold and silver would become common metals.

Whaling has been an important fishery for hundreds of years, but modern methods have killed whales so rapidly that the animals are becoming quite scarce. Formerly found in great numbers in many parts of the Atlantic and Pacific oceans, they are now found mainly in Ross Sea in the Antarctic. However, whales are still caught off the coasts of California, the Azores Islands, Korea and Alaska. Among the most valuable products of this fishery are: spermaceti, a fine oil

found in the sperm whale; whale oil, from blubber, used to lubricate delicate machinery and in the manufacture of soap and glycerin; and whalebone, used where great stiffness is required, for handles on canes and umbrellas, and in the manufacture of certain surgical instruments. Cattle feed and chicken feed are made from the flesh and bones of the whale; and the bone, which is rich in phosphates, is made into fertilizer. Glue is also made from certain parts of the whale. Whale meat is eaten in Japan and Norway, and in New Zealand it is canned.

Another valuable product of the whale is ambergris, a lumpy, fatty substance found only in sick whales. Hundreds of pounds of this valuable material are produced by one whale. Sometimes ambergris is found in the stomach of the whale and it may be found floating on the ocean. It is used as a base for perfumes and is valued at more than $20 a pound. One reason for its costliness is that it is not easily found.

The seal fishery is another important industry of the sea. The fur seal has a coat of beautiful, soft, glossy fur that is greatly prized. Fur seals are found throughout the southern seas but chiefly in the North Pacific and the Bering Sea. The main seal fisheries here are on the Pribilof Islands, which belong to the United States.

For many years seal-hunters killed all the seals they could find. This resulted in a great decrease in the number of seals. To stop this slaughter and to increase the size of the herds, an agreement was made in 1911 among the United States, Canada and Japan. This agreement limited the hunting season and the number of seals that could be killed, and prohibited the killing of seals in the open sea. Japan withdrew from this agreement during World War II. Early in 1944, Canada and the United States made another fur-seal treaty. This provides for continued protection of the seal herds.

Many other animals that live at least part of their lives in the water are valuable fur-bearers. Among them are beavers, otters and muskrats. Whales and seals and the other fur-bearing animals are discussed more fully in other articles in your BOOK OF KNOWLEDGE (see the Index).

Water power, one of the greatest sources of the world's wealth, is the use of the energy of falling water to do mechanical work. Water power (sometimes called "white coal") may one day be more important than power from coal or oil, since water power is constantly renewed for us by Nature. Before the invention of electrical devices, the machines run by water power were very simple. They had to be placed near falling water, and there was no way of transporting the power. Today the falling water in isolated places can be used to make electricity which can be carried long distances, to light cities, run factories and do other work. Hydroelectric development has not yet reached its peak.

Sovfoto

Seal hunting is an important industry, since the beautiful glossy fur of these animals is greatly prized. Seals are found chiefly in the North Pacific and the Bering Sea. This scene is on the Commander Islands, U.S.S.R.

U. S. Dept. of the Interior
Spillway, Grand Coulee Dam, on the Columbia River.

Of all the natural resources of man, water power has probably been developed the least The United States has about one-third of the total developed water power of the world, yet only about one-fifth of the possible water power in the country is being used. Norway, Sweden and Switzerland have made the greatest use of their available water power. The greatest water-power resources are in Africa, where water power is least used. There is more information about this important natural resource in the article Water Power of the World.

HOW PEOPLE DERIVE PROFIT FROM PLACES OF WATER RECREATION AND WATER CURES

The fact that water is a source of pleasure and relaxation to many people has also made it a source of wealth to some. Wherever there is good swimming or beautiful scenery, whether along the coast or inland along lakes and rivers, we find vacation resorts. In certain parts of the world, particularly in France, Germany and the United States, mineral springs and hot springs are of value in the cure of some illnesses, and profitable health resorts often develop there.

The fascinating story of the development of ships is told in other articles (see the Index). Now the oceans of the world are a broad highway for a vast intercourse between nations. One of the most profitable trade routes is in the North Atlantic between Canada and the United States on one side and Europe on the other. Another Atlantic trade route is between North and South America. Valuable cargoes are carried through the Panama Canal and on to Hawaii, the Philippines and the Far East. Ships from Europe go through the Suez Canal to Africa, Asia, the East Indies, Australia and New Zealand. Countries whose shipping is of world-wide importance are the United States, Canada, Norway, the Netherlands, France and Sweden.

Settlement of the United States and Canada followed the rivers. The greatest inland waterway is the Great Lakes system. The governments of the two countries are now working on a plan whereby ocean-going steamers will be able to sail from the Gulf of St. Lawrence to the Great Lakes. In Europe, canals and canalized rivers are used for transportation of goods to a far greater extent than in America—particularly in Russia, Germany, Holland, the Scandinavian states and France.

By FLORENCE V. GEEHR.

THE NEXT STORY OF THE EARTH IS ON PAGE 4973.

ITALY AND ITS STORY

WE have already told you the wonderful story of the Roman Empire. The heart of this mighty state was the Italian peninsula, in which Rome, the capital city, was situated. Italy was the political and literary centre of the Empire, and the natural place of exchange for the merchandise of the North, South, East and West. It was also a great military centre, from which the legions of Rome departed on their triumphant expeditions.

The ancients thought that the Roman Empire would last forever, but it went the way of all the great states of antiquity—Assyria, Persia, Macedon, Carthage and the rest. One portion of the Empire, indeed, survived until almost the end of the Middle Ages. You see, in the fourth century the Empire had been divided into two parts. From this time on there was a Western Empire, with its capital at Rome, and an Eastern Empire, with its capital at Byzantium (the modern Istanbul). The Eastern Empire, which came to be known as the Byzantine Empire, had a long and colorful history. It was finally overthrown by the Turks in the year 1453.

The Western Empire was under almost constant attack by the German tribes from the north. In the fifth century the barbarians swarmed into the Empire by the thousands and the emperors offered only feeble resistance. At last, in the year 476, the Western Empire came to an end when the last emperor, the boy-king Romulus Augustulus, was dethroned by Odoacer, a German military leader.

Italy, which had been the centre of the civilized world, was now a spoil of war to be fought over by foreign soldiers. Odoacer, who had deposed the last Roman emperor, was overcome in his turn in 493 by Theodoric, the king of the German people known as the Ostrogoths. Theodoric acknowledged the ruler of the Eastern Empire as his master. His successors, however, became more and more independent of the Empire. At last the emperor Justinian I (483-565) decided to send his armies to Italy in order to do battle against the Ostrogoths. The latter were conquered and in the middle of the sixth century Italy came under the direct control of the Eastern Empire.

Keystone View Co.
Giuseppe Garibaldi, who made Italy a nation.

The rule of the Empire over all of Italy lasted but a short time. In 568 the powerful German tribe of Lombards invaded the peninsula and conquered the northern part of it. The eastern emperors continued to rule for a time over certain scattered regions of Italy, mainly along the coast.

The Lombards were masters of northern Italy for several hundred years. They did not succeed, however, in extending their power over the whole of the peninsula. For one thing, they were opposed by the popes. As you probably know, these great religious leaders had originally been simply the bishops of Rome, but they had gradually acquired greater power. At the time of the Lombard occupation, the pope was recognized as the religious leader of the West.

In the eighth century the Lombards began to extend their possessions southward. Pope Stephen III, alarmed, sought the help of Pepin, the king of the Franks, a German tribe that had become strong in what is now southern Germany and France. Pepin defeated the Lombards and gave some of their territory to the Church. Some years later Charles, the son of Pepin, came to the aid of another pope when the Lombards threat-

ened. Charles, who was later to be known as Charlemagne or Charles the Great, routed the Lombards. He put an end to their kingdom, which he added to his own realms.

HOW CHARLEMAGNE BECAME RULER OF THE HOLY ROMAN EMPIRE

By the year 800 Charlemagne ruled over a great kingdom, which included France and a large part of Germany and Italy. In that year he was crowned by Pope Leo III as the ruler of a new state, the Holy Roman Empire. This empire was intended to be a kind of super-government, set over all the kings and peoples of the earth. It would revive, so it was hoped, the glories of the old Roman Empire under the religious guidance of the Church.

As a matter of fact, the Holy Roman Empire never succeeded in uniting the peoples of the earth. Although its territories included, at various times, Italy and certain other non-German territories, the Holy Roman Empire was really a German state. (The word German applies here to the German-speaking areas of western Europe and not to the country of Germany as we know it to-day.) The emperors were practically all Germans and they were chosen by an Electoral College made up of German princes and of German leaders of the Church.

It had been hoped that the establishment of the Holy Roman Empire would assure Italy of unity and prosperity under a great monarch. These hopes were not realized. Most of the emperors were unable to make their authority respected in Italy. They were often defied by the popes, who were not only the religious leaders of western Europe but also the lords of considerable Italian territory. They were defied, too, by foreign invaders who established themselves in various parts of the peninsula. The most successful of these invaders were the Normans, who, in the eleventh century, seized Sicily and a part of the southern mainland. They set up the kingdom of the Two Sicilies, which included within its territories the important city of Naples.

In the north such cities as Florence, Venice, Milan and Genoa became more and more independent. They became the strongholds of a sturdy middle class that defied the efforts of the emperors to subdue them. These cities would sometimes unite against a common foe, but they were generally rivals —commercial rivals as well as political.

Italy, therefore, presented a very confused picture in the Middle Ages. There were a number of more or less independent cities in the north. In the centre there were the Papal States, the territory ruled over by the pope. There was the kingdom of the Two Sicilies in the south. Last and perhaps least, there was the Holy Roman Empire, which claimed sovereignty over much of Italy, but which exercised less and less real power as time went on. These different states formed alliances with and against one another and were continually fighting. Their rival claims drove out of all minds the idea of a united, prosperous and peaceful Italy.

Yet, in spite of the constant strife and the lack of unity within her borders, medieval Italy produced wonderful works of literature and art, about which we tell you elsewhere in The Book of Knowledge. She led the way in the fourteenth century in that great revival of classical learning that we call the Renaissance. (See Index.) The towns of Italy tried to surpass one another in the beauty of their painting, their sculpture and their cathedrals. The most renowned of all these towns was Florence. It was the city of Dante and Giotto, of Michelangelo and Leonardo da Vinci. It was the home of the Medici family, world-famed patrons of art and learning.

THE FIVE POWERS THAT KEPT A BALANCE IN ITALY

Toward the end of the fifteenth century five great powers in Italy stood out above all the rest. They were the duchy of Milan, the Papal States, the kingdom of the Two Sicilies and the republics of Florence and Venice. There was a sort of unwritten agreement between these states that no one of them was to dominate the rest; there was a real balance of power, such as we describe elsewhere. (See Index.)

This delicate balance was disturbed toward the end of the century, when Charles VIII, king of France, laid claim to the throne of the Two Sicilies. In 1494 this ambitious monarch invaded Italy in order to make good his claim. He met with practically no resistance at first and he entered Naples in February, 1495. Charles's ambitious designs, however, soon stirred up great uneasiness in Italy. Before long he was opposed by a league made up of Italian and foreign states. He was defeated by the military forces of the league and he had to flee from Italy.

The French made other attempts to establish themselves in Italy. They met with fierce opposition, particularly from the Span-

ITALY'S GREAT STRUGGLE FOR UNITY

With their country split up into many badly governed states, the people of Italy longed to be a united nation. All agreed that the first step was to drive the Austrians out of Italy, and several unsuccessful attempts were made. In 1859 Sardinia, with the help of France, defeated the Austrians at Palestro.

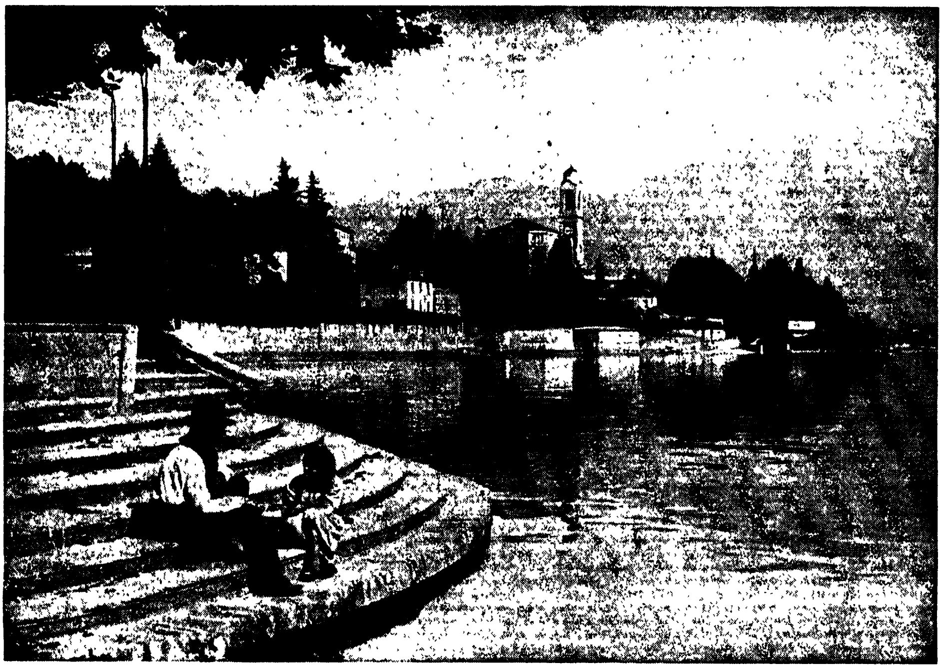
Four days after the battle of Palestro the Austrians were again severely beaten at Magenta by the French, and the emperor Napoleon III, with the king of Sardinia, made a triumphal entry into Milan.

The success of Sardinia roused enthusiasm all over Italy, and the demand for unity became universal. The Austrians again suffered defeat at Solferino, and Napoleon was acclaimed victor on the battlefield, as shown here. But he became jealous of Sardinia, made peace with Austria, and fought to prevent the Italians taking Rome. It was not till 1870 that Italy really became a nation, with Rome as its capital.

iards, who had ambitions of their own in the peninsula. By 1530 Spain had become the dominant power in Italy. Of the five Italian states named above, the kingdom of the Two Sicilies had become a viceroyalty of Spain. (A viceroyalty is a province ruled over, in the name of a king or an emperor, by a governor called a viceroy.) The duchy of Milan was occupied by Spanish troops. The Papal States and Florence had lost much of their political power and were forced to acknowledge Spanish supremacy. Only Venice kept her independence.

Spanish domination in Italy lasted until the first years of the eighteenth century. The Spaniards looked upon their Italian possessions as conquered territory, to be treated without mercy. Taxes became continually higher. The money that was collected enriched the Spanish treasury and the viceroys sent to Italy from Spain. The Italians who were under the direct rule of Spain became a subject race; many of the others were not much better off. Enthusiasm and ideals were gradually lost; men occupied themselves with unimportant things. Italian literature and art lost their proud claims to glory.

By the beginning of the eighteenth century Spain had become a second-rate power. France and Austria now fought over Italy and Austria was the victor in the struggle. She held much of northern Italy, including the large province of Lombardy, and her influence extended elsewhere in Italy. The famous Bourbon family, members of which occupied the thrones of France and Spain, was also influential in Italy at this time. A Bourbon reigned over the Two Sicilies; Bourbons also governed several smaller Italian states.



By the waters of Lake Como, one of the most beautiful lakes in Lombardy. Virgil and Claudian celebrated its glories; the two Plinys were born there. Bellagio with its splendid villas is a lovely spot.

In the year 1789 a great revolution broke out in France. The king, Louis XVI, was forced to give France a constitutional government. In 1792 the queen of France, Marie Antoinette, was accused of plotting with her brother, the emperor of Austria, to overthrow the newly elected representatives of the French people. The indignant French declared war on Austria and on Prussia, Austria's ally. This began a series of wars that was to involve all the nations of Europe and that was to make the continent a great battlefield for years to come.

In the year 1796 the tide of war swept over Italy. The great French general, Na-

poleon Bonaparte, crossed the Alps and defeated the Austrians in northern Italy in a series of brilliant battles (1796-97). French power became continually greater in the peninsula and at last the French were in full control.

A series of republics had been set up by the French in various parts of Italy. Later Napoleon became emperor of the French, and these republics disappeared. A part of Italy was annexed outright to France. Another part, including Lombardy, Venetia (the district of which Venice was the capital) and Rome, became the kingdom of Italy, with Napoleon himself as king. A third part, the kingdom of the two Sicilies, was ruled by a puppet king, appointed by Napoleon.

THOUGH ITALY PROSPERED, NAPOLEON, THE CONQUEROR, WAS NOT POPULAR

Great changes took place in Italy at that time. The government became more efficient. New educational institutions were set up; old ones were modernized. The courts were improved; all Italians became equal before the law. There was freedom of thought. New roads were opened; large canals were dug. Agriculture, industry and commerce were encouraged. Most Italians greeted these changes with great satisfaction. Yet they were not satisfied with French rule. For one thing, they could never forget that the French were foreigners. Again, they were indignant when their young men were taken from their homes to serve in Napoleon's armies.

After his vainglorious Russian campaign (1812-13) had turned into a terrible military disaster, Napoleon's star began to set. In the autumn of 1813 the Austrians attacked the French in northern Italy. They had already won a number of successes when news came, in April, 1814, that Napoleon had been forced to abdicate (give up his throne).

AFTER NAPOLEON'S FALL, AUSTRIA BECAME POWERFUL IN ITALY

Almost all the former rulers of Italy regained their possessions. The Papal States were returned to the pope. A Bourbon prince reigned again over the kingdom of the Two Sicilies. As before, the dominant power in Italy was Austria. Lombardy and Venetia now belonged to that country. Austrian princes reigned over Tuscany, Parma and Modena. The power of Austria made itself felt in other states of Italy.

Napoleon returned to power for a short time in 1815, but he made no effort to interfere again in Italian affairs. After the English and Prussians had crushed his armies at Waterloo, his career was definitely at an end.

THE RULE OF THE AUSTRIANS WAS CORDIALLY HATED

The Italians were no longer under French rule, but they found themselves worse off than before. The Austrians and the returning princes determined to destroy all the good things that the French had brought to Italy—educational opportunities, freedom of thought, equality before the law and so on. The Italians were soon up in arms over the loss of their rights.

From 1815 until 1870 Italian patriots did not cease in their efforts to regain these rights, to drive out all foreigners and to bring about unity in Italy. This struggle is known as the *Risorgimento,* which may be translated as Reawakening. Austria was the chief villain of this struggle, though there were other villains. There were many heroes, too, some of whom gave their lives so that Italy might be free.

THE SECRET SOCIETY OF THE CARBONARI, AND MAZZINI'S PATRIOTIC SOCIETY

The fight against tyranny was carried on at first by a number of secret societies, of which the most famous was that of the *Carbonari* or charcoal-burners. They took their name from the charcoal-burners of the Abruzzi mountains, where the society was formed. The *Carbonari* brought about a series of uprisings in various parts of Italy, but none of them had lasting success. The *Carbonari* had about lost their influence when, in 1831, a young Italian patriot, Giuseppe Mazzini (1805-72) of Genoa, founded a new society called Young Italy. The members of this society were pledged to work openly to make Italy united, independent and republican. They did much to kindle the fire of patriotism in the Italian people.

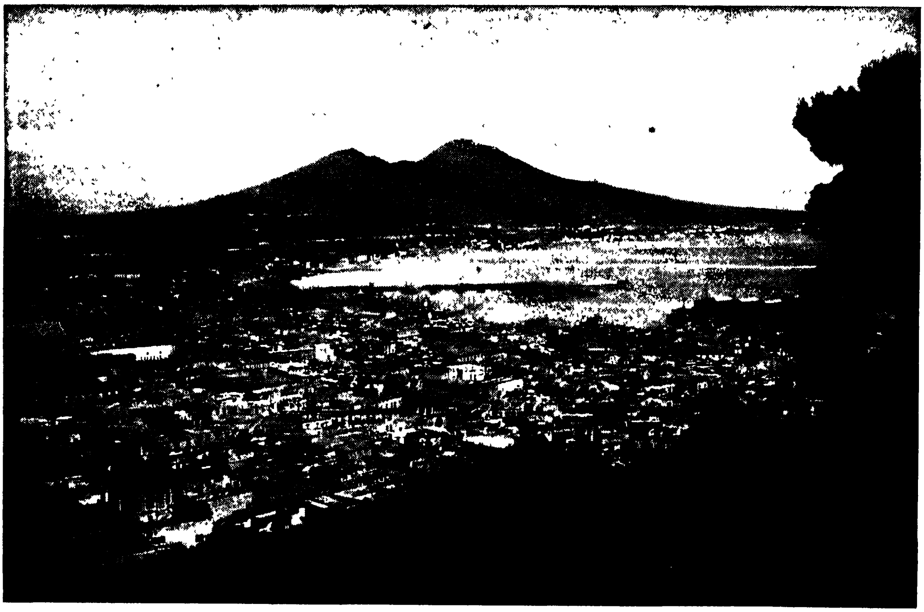
In 1848 the situation became quite hopeful. This was a year of revolution all over Europe—in France, in Austria, in Prussia, in Spain. In Italy, too, the standard of revolt was raised. The Sicilians rebelled against their king, Ferdinand II. Charles Albert, the king of Sardinia, who sympathized with the cause of Italian independence, declared war on Austria and swore that he would drive the hated foreigners out of the peninsula. A band of republicans under Giuseppe Garibaldi (1807-82), one of Italy's

great heroes, captured Rome. A republic was set up in that city under Mazzini and two other leaders.

Unfortunately things turned out badly. Charles Albert was defeated by the Austrians, abdicated and turned over the kingdom of Sardinia to his son, Victor Emmanuel II. King Ferdinand crushed the revolt in the kingdom of the Two Sicilies. The Roman republic was overthrown. Things were as bad as before.

From this time on, the cause of Italian independence was served chiefly by two men—by Victor Emmanuel II, king of Sardinia, and by his minister, the Count of Cavour. They were determined to unite all Italy under their rule. To show Italians how they could hope to benefit under such a rule, the two great Sardinians made their kingdom a model state, where there was freedom and justice for all. They then laid their plans carefully for the overthrow of the Austrian power in Italy. At last they succeeded in winning the support of the emperor Napoleon III of France.

In 1859 the combined armies of France and Sardinia defeated the Austrians in a series of bloody battles, the most famous of which were Magenta, Solferino and San Martino. Just when the cause of the allies seemed most hopeful, Napoleon suddenly called a halt. He signed an armistice with Austria, and Victor Emmanuel was compelled to accept the terms of peace that followed. Lombardy and a number of other districts in Italy were turned over to the king of Sardinia. Napoleon received the Sardinian territories of Savoy and Nice. Austria kept Venetia.



No city is more picturesquely situated than Naples, standing, as it does, by the blue waters of the Mediterranean, with the threatening crater of Vesuvius frowning upon it, and belching out clouds of smoke as though to remind the people of the fate of Pompeii, close by. But Naples is not only beautiful: it is a great centre of trade, an important naval and military station, and one of the largest cities of Italy. Naples was founded by the Greeks. Its original name was Neapolis (New City).

The people of the Two Sicilies were still enslaved; their ruler was the brutal Francis II, who had succeeded Ferdinand II. Garibaldi now determined to overthrow the tyrant. He set out from Genoa in 1860 with only a thousand men. When he landed in Sicily, he was greeted with great enthusiasm and the Sicilians hastened to join his ranks. Soon all Sicily was free and Garibaldi turned his attention to Naples. Victor Emmanuel came to his aid and helped him to capture the city.

The kingdom of the Two Sicilies now became a part of Victor Emmanuel's possessions. His task of liberation completed, brave Garibaldi returned to his farm on the island of Caprera with a bag of beans for

the spring planting. In 1861 a parliament with representatives from all parts of the peninsula met in Turin; it proclaimed the kingdom of Italy.

HOW THE POPE BECAME A PRISONER IN THE VATICAN

Only two provinces were now lacking to make Italian unity complete—Venetia and Rome. In 1866 the Italians joined the Prussians in a war against Austria; after the defeat of Austria they received Venetia as their reward. In 1870 Rome, too, was added to the Italian kingdom. An army under General Raffaele Cadorna fought its way into the Imperial City, defeating the papal troops. In 1871 Rome became the capital of Italy. Pope Pius IX refused to accept the new state of affairs. He declared himself the "prisoner of the Italian revolution" and thereafter he refused to leave the Vatican. His successors followed his example until 1929, as we shall see in the next article on Italy.

Italy was at last a united country. There were still, however, certain regions—the city of Trieste and the districts of Istria and the Trentino—which Austria held but which patriotic Italians claimed for their own land. They called these districts Italia Irredenta (Unredeemed Italy).

In January, 1878, the great Victor Emmanuel II died and was succeeded by his eldest son, Humbert I. Humbert's reign was not a happy one. He managed to acquire certain colonies in eastern Africa, but his ambition to found a great Italian empire in Africa was rudely shattered in 1896. In that year the troops of the Abyssinian king Menelik II inflicted a terrible defeat on the Italians at Adowa. The Italian people now demanded an end of colonial adventure. In the next few years there was great unrest all over Italy, and the government took stern steps to suppress it. King Humbert became very unpopular and at last he was assassinated in 1900. He was succeeded by his son, Victor Emmanuel III.

In the early years of the twentieth century Italy revived her dreams of a great Italian empire in Africa. This ambition caused her to come to blows in 1911 with Turkey over the province of Tripoli, which Italy wanted and which Turkey did not wish to give up. As a result of this war, which ended in 1912, Italy won control over considerable territory in northern Africa, including Tripoli.

In 1882 Italy had joined Germany and Austria in a Triple Alliance, chiefly because she did not want to see France and England becoming too strong in the Mediterranean regions. Many Italians frowned on the alliance. For one thing, Austria was Italy's old enemy. Then too, as we have seen, Austria held Italia Irredenta, which patriotic Italians thought should belong to Italy.

Under the terms of the Triple Alliance, Italy pledged herself to come to the aid of Germany or Austria if either was attacked. When World War I broke out in 1914, Italy declared herself a neutral; she said that Germany and Austria had not been attacked but that they themselves had begun the struggle. The anti-Austrian elements in Italy, under the leadership of the poet Gabriele d'Annunzio, demanded that Italy should take an active part in the war on the side of the Allies. At last, on May 3, 1915, the Italian Parliament announced that Italy was going to withdraw from the Triple Alliance. On the 15th of the same month, Italy declared war on Austria. (She was not officially at war with Germany until August, 1916.)

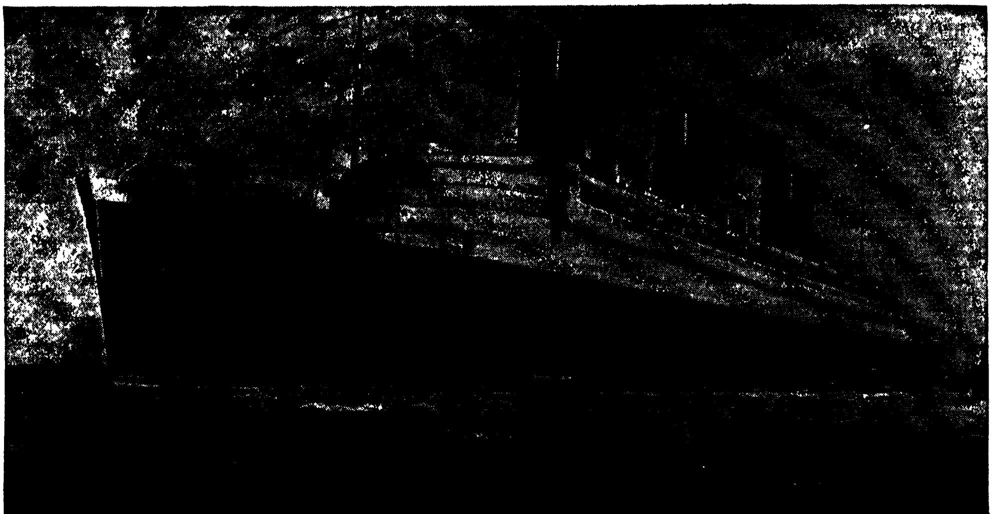
HOW THE ITALIANS FOUGHT IN WORLD WAR I

Upon entering the war, the Italians attacked the Austrians along the mountainous Austro-Italian frontier and made advances all along the line. For more than two years the progress of the Italians was slow but it seemed to be sure. Suddenly, in October, 1917, a combined force of Germans and Austrians attacked the Italians at Caporetto, on the Isonzo River, and inflicted a disastrous defeat. The Italians did not succeed in halting the rout until they reached the banks of the Piave River. The gains of two years had been lost.

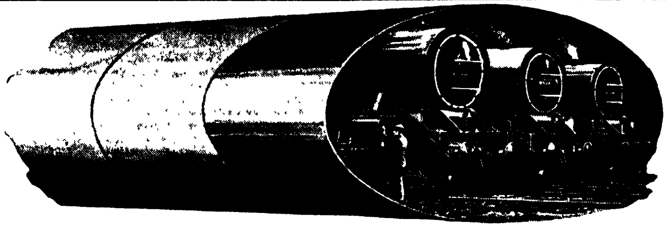
The Italians now had to reorganize their shattered armies. At last, in October, 1918, they struck again. They defeated the Austrians so badly in the battle of Vittorio-Veneto that Austrian resistance soon collapsed. The Austrians had to sue for peace and on November 3 they signed an armistice with the Italians. Thus Italy, which had endangered the Allied cause by the defeat at Caporetto, helped to bring about the final victory of the Allies by making the Austrians abandon the fight.

Great changes took place in Italy after the end of World War I. We shall tell you about these changes in the article beginning on page 4565.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 4445.



The Queen Mary dwarfs the tugboats and other harbor craft that surround her. She is taller than Niagara Falls and her length is greater than the height of the Eiffel Tower in Paris.



Pictures, courtesy, Cunard White Star Line

Left—Each of the funnels on the Queen Mary is about thirty feet in diameter. This is big enough around to let three large locomotives pass.

A GREAT MODERN SHIP

CAN you imagine a city floating on the ocean? In your wildest dreams have you ever seen a big hotel moving full speed ahead over the waters? Or a huge refrigerated warehouse churning through the waves? It may all sound like Alice in Wonderland, but these things do happen—when a great modern ship puts out to sea.

We can divide merchant, or commercial, ships into classes by many methods. It is possible to separate them according to what they carry, according to what means of power they have, according to the fuel they use or in any of a dozen other ways.

One of the most important divisions is the first one—classifying them by what they carry. Accordingly, we see that there are four groups of steamships: (1) express passenger and mail; (2) combination passenger and mail; (3) cargo; and (4) tramp.

Each of the above classes is easy to understand excepting the fourth or tramp class. By a tramp steamer is meant a cargo vessel, usually small and slow, which has no fixed plan of travel, or itinerary. It sails from port to port, picks up some wheat here or some timber there, and is ready to go anywhere the shipper pays to send it.

However, if you yourself have ever made an ocean voyage, or seen a great steamship or even looked at pictures of modern liners, the type you remember is the passenger vessel. It is usually the biggest, the fastest and the most well equipped.

So, in our story, let us take a look at passenger ships. Many of their features will also be found on cargo vessels.

If your father wanted to travel across the ocean on business, he might decide to take the family along. He would first make reservations, or, as they say when dealing with ships, he would book passage. The ship he chose would probably be fast, comfortable and safe. He might choose the Queen Mary, a superliner of the British Cunard White Star Line. It is the largest ship ever built,

with one exception. The Queen Mary's sister ship, the Queen Elizabeth (ships are always spoken of as girls) is slightly larger.

The Queen Mary is one of the finest present-day liners. An inside view of this "floating city" will give us a picture of all modern passenger steamers.

The size of twentieth-century vessels like the Queen Mary and the largest United States vessel, the America, is perhaps one of the most amazing factors about them. In the articles The Reign of Wooden Ships and Conquerors of the Sea, you have been told of the fast sailing clippers and the first steamships. The bow-to-stern dimension (the bow is the front end and the stern is the back end of a ship) of these vessels ranged up to 300 feet and their weight to 2,000 and 3,000 tons.

The Queen Mary weighs over 80,000 tons, and its overall length is 1,019.5 feet. The three vessels used by Christopher Columbus on his first voyage to America, the Niña, the Pinta and the Santa Maria, could be placed in the restaurant and main lobby of the Queen Mary, with space to spare! It would take forty miles of freight cars to carry her weight!

You know that houses and buildings have different floors—cellar, first floor, second floor, third floor and so on. On ships these divisions are called decks instead of floors. They are not given numbers, but are called by letters, such as A Deck, B Deck, C Deck and so on. Often they receive special names, too, like Sports Deck, Sun Deck, Promenade Deck or Main Deck.

On the Queen Mary we have twelve decks, besides the holds and space for machinery. A hold is the space below decks where cargo and supplies are stored.

The Sports Deck is the topmost deck. Here we find space marked off for various games and sports. On shipboard some of the favorites are shuffleboard, deck tennis and golf, quoits, handball and paddle tennis.

Here, too, you will find the outside portions of the huge funnels used to direct engine smoke away. From the outside these large tube-like structures run down inside the ship to the engine room.

The bridge is on this deck, too. But what is the bridge? This part of the ship is the very heart of all operations, like the headquarters of an army's general. From here the captain, or master of the vessel, as he is known, directs all the activities that cause the ship to run safely and speedily on her correct path, or course. He can communicate with all parts of the ship at any time; a flip of his hand can stop the vessel, or turn it to port or starboard. In a sailor's language port means left and starboard means right.

Either the captain or one of the ship's other officers is on the bridge at all times. He is said to be on watch, or on duty.

A ship's crew is usually divided into two parts, called the port watch and the starboard watch. Each works at a different time; when one is on duty, the other is off.

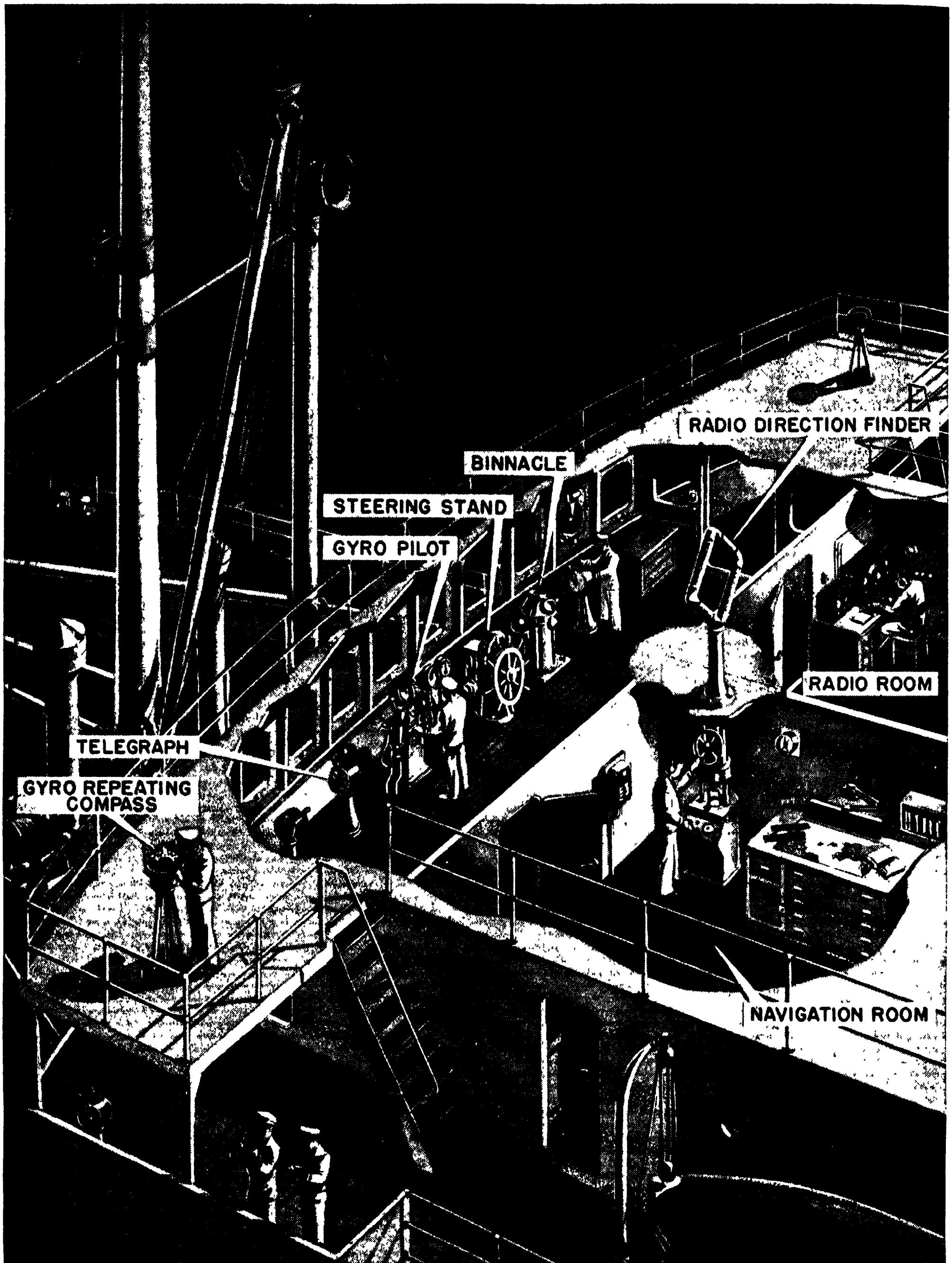
The division of watches in this manner is the result of an old custom that saw the men of each watch quartered on opposite sides of the ship. A man's "quarters" are his living quarters—his bunk (bed) and his belongings.

Another use of the term "watch" refers to an interval of time itself. The twenty-four hours of the day are divided into six four-hour watches. Starting with the period from midnight to four in the morning, we

Courtesy, Cunard White Star Line

The bridge house on the Queen Mary, showing the engine telegraphs, the binnacle, the gyropilot and the steering stand. From here the captain directs the ship's course.

A SHIP IS COMMANDED FROM THE BRIDGE



The center of operations on every ship is the bridge. From here the captain, or the officer who is on watch, may change the speed and direction of the giant liner; from here he may communicate with any part of the vessel. In the radio room close by, an operator keeps contact with stations all over the world. The navigation room contains all the ship's charts, by which courses are planned, and also the valuable radio direction-finding equipment.

have the middle, or midwatch (midnight to 4 A.M.); the morning watch (4 A.M. to 8 A.M.); the forenoon watch (8 A.M. to noon); the afternoon watch (noon to 4 P.M.); the dog watch (4 P.M. to 8 P.M.) and the first watch (8 P.M. to midnight).

The dog watch is often broken up into two two-hour periods. This gives officers and men an opportunity to have different hours from day to day, since it shifts the entire schedule.

IF YOU KNOW WHAT WATCH IT IS, YOU TELL TIME BY THE NUMBER OF BELLS THAT RING

Time is noted by the striking of a bell every half hour. Each watch, therefore, being four hours long, hears the bell ring at eight different times. At noon, for instance, the bell rings eight times. At half past twelve it rings once. At one o'clock it rings twice, and so on up to eight times again at four o'clock. Then the ringing starts all over again for the next watch.

During the dog watch, then, when you hear somebody say, "It's four bells," you will know that it is six o'clock and time to think about dinner.

Before we leave the subject of shipboard time, let us mention chronometers. The term itself comes from the Greek words *chronos* and *metron,* meaning time and measure. A chronometer is a time-measuring device, a clock. But it is a very special and extremely accurate clock, because knowing the correct time at sea is important.

IMPORTANT INTRUMENTS FOR NAVIGATING AT SEA ARE LOCATED ON THE BRIDGE

On the bridge you will see many of the instruments used in the operation and navigation of the vessel. Look at page 4416 for a picture of the bridge and some of the nearby rooms.

You will find there the gyro repeating compass, a device which "repeats" the information shown on the gyrocompass. The latter is the main gyro instrument on shipboard and indicates the correct direction at all times. It is usually kept below decks somewhere in a clean, safe place. The course information is sent automatically to the "repeaters," which may be located in many places to show correct direction to different people. On the bridge there is a repeater on the port side, one on the starboard side and one in the steering stand. The captain may have one on the bulkhead, or wall, of his quarters. The navigation room will have one, too.

The steering stand usually contains a gyro repeater, as we said, and also the steering wheel.

The gyrocompass acts very much the same as a simple gyroscope. You have probably seen one of these, or at least a picture of one. The gyroscope is a well-balanced wheel, able to spin very rapidly about one axis, and, besides that, to turn freely around a horizontal and a vertical axis.

By using the special properties which this instrument possesses, the gyrocompass is able to indicate true north at all times. Unlike the magnetic compass, it is not bothered by electric or magnetic forces, masses of steel or the weather. It is truly a wonderful invention.

IT IS POSSIBLE TO STEER A GREAT SHIP AUTOMATICALLY AND WITHOUT HUMAN HANDS

The gyropilot is another member of the gyroscope family. It is an automatic steering device, much more accurate than the human hand, which makes use of the "correct course" information provided by the gyrocompass. The pilot is connected to a power unit in the steering engine room. Any deviation of the ship from the correct course sends a message to this power unit electrically. The rudder is then turned automatically to bring the ship back to the proper direction of travel. Sometimes this instrument is called by the nickname "metal mike."

Next to the steering stand in the picture on page 4416 you will see the binnacle. This is a stand, or case, for the ship's magnetic compass.

The telegraph on the bridge is not a telegram-sending device; and yet it does send messages. It is the connecting link between the bridge and the engine room. When the captain wants to "talk" to the engine room, he moves the telegraph handle to a certain position on a lettered dial. It may read "Full Speed Ahead," "Half Speed Astern" or something else. Immediately a similar handle on the engine-room telegraph moves to the corresponding position on its dial. Thus the engine-room men get the "message" from the bridge.

WHEN IT IS FOGGY OR STORMY, THE CAPTAIN USES RADIO TO TELL HIM WHERE TO GO

The radio direction finder, or RDF, is an electrical instrument used on shipboard to help determine position, when conditions of weather or visibility make other means of navigation unreliable.

It consists of an extremely accurate and sensitive receiving unit, and a rotating-type

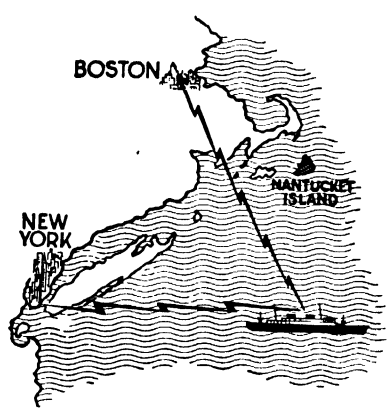
loop antenna. Your radio at home is a receiver, too, but it probably has a straight wire antenna, or aerial.

The RDF antenna is located on deck. A handle for turning it and a compass card are found in the chart room below. See the illustration on page 4416.

If the RDF is tuned in on a shore station—for example, one near New York—the received sound (signal) fades to a minimum when the loop is turned broadside to the sending station (transmitter). It is also possible to use the less accurate method of turning the loop until a maximum return is received. This indicates that the plane of the loop is pointing at the sending station.

To illustrate the two methods, let us refer to the loop position as shown in the picture on page 4416. If we use the so-called null, or minimum return, method, the sending station will be on a line extending fore and aft through the ship. If the maximum-response system is used, the transmitter is on a line running across the ship, from port to starboard.

How do you know whether the transmitter is in front or back of you on this line? Well, that requires an additional little device, but one can then read accurately on the compass card the direction of the ship from the sending station. This is called the bearing of the ship from that station.



Two radio bearings, say, from Boston and New York City, will give you a ship's position, as explained in the text.

Repeating the operation for another transmitter near Boston, a second bearing is obtained. Taking a bearing means the determination of your direction in relation to a known point.

When the two bearing lines are drawn, as in the sketch on this page, the ship's position is found where the lines join. In our particular example this is just south of Nantucket Island.

This entire process is called taking a "fix." If greater accuracy is desired, more than two bearings may be taken.

As we mentioned, the RDF is usually located in the navigation, or chart, room. Here the course is plotted, maps are studied, weather reports are inspected and the ship's log is maintained. The log is a detailed accounting of events, including all bearings, changes in course, ship positions at different times and weather notations. It is kept chronologically, that is, in order of time, by day and hour.

The radio, or wireless, room is shown next to the navigation room. Here all radio contact with other ships, with airplanes and with land is made. Here, too, you may send radiograms—telegrams sent by radio—when you are a passenger.

One of the other modern navigation instruments on the bridge is the fathometer, a device for measuring the depth of the water through which the ship is sailing. To split up the word, it is a fathom-meter. A fathom is a distance equal to six feet.

Explained simply, the fathometer bounces a sound against the ocean bed, or floor, and measures the time necessary for the echo to reach the ship. The depth of the water is then found easily, since we know that sound travels about 4,800 feet a second. Measurements are made twenty-four times every minute.

In the old days the sailors used to throw a weighted string into the sea. They would determine the water's depth by measuring the length of line sent out before the weight hit the ocean bottom.

Instead of having what you call in your car a speedometer, a ship has a pitometer. This instrument indicates speed in knots by measuring the velocity of the water as the ship churns through the ocean. A knot is a nautical mile per hour; it is equal to 1.152 times a land mile.

The next deck, that is, the deck below the Sports Deck, is the Sun Deck. On this level there is a gymnasium, a grill, or snack bar, a squash court and some staterooms. A stateroom is just another name for cabin, or room, especially for the passengers on board ship.

We can go down the companionway, or stairway, from the Sun Deck to one of the smoking rooms on the Promenade Deck. On this deck we will also find writing rooms, a promenade—one of the most popular activities on a sea voyage is walking around the deck, or promenading—a galley, that is,

a cooking place or pantry, a children's playroom and a shopping center.

The children's playroom is one of the very attractive fun centers for young folks at sea. Here you will find hobby horses, dolls, building blocks and wall-paintings telling the stories of popular nursery-tale characters like the Man in the Moon and the Three Little Pigs. A slide, a brightly painted sentry box and a log cabin are other attractions.

Another delight might be the miniature aquarium with real tropical fish. Or the small movie theater which children can run themselves by merely pushing buttons. Or the doll's house, well supplied with furniture and cooking utensils.

The shopping center brings to sea some of the features of a big city department store. If you want clothing, food, jewelry or simply souvenirs, they are to be found here. Imagine being miles and miles out on the ocean and still having these fine stores "right down at the corner!"

Stepping into one of the twenty-one electric elevators (lifts) of the Queen Mary, we ride down to the next, or Main Deck. Toward the stern there is a bridge, much smaller than the main bridge. It is called the docking bridge; from here the captain can direct his crew when the ship has to back into a pier.

Sailors aboard an American liner spread an awning for the comfort of the passengers.

"Shooting the sun" to help find the ship's position.

There are more staterooms and cabins on this deck, and, among other things, another smoking-room and a tourist lounge. By a lounge we mean a big parlor, with chairs and sofas all around, and perhaps a radio playing soft music. This particular one is for the use of tourist-class passengers.

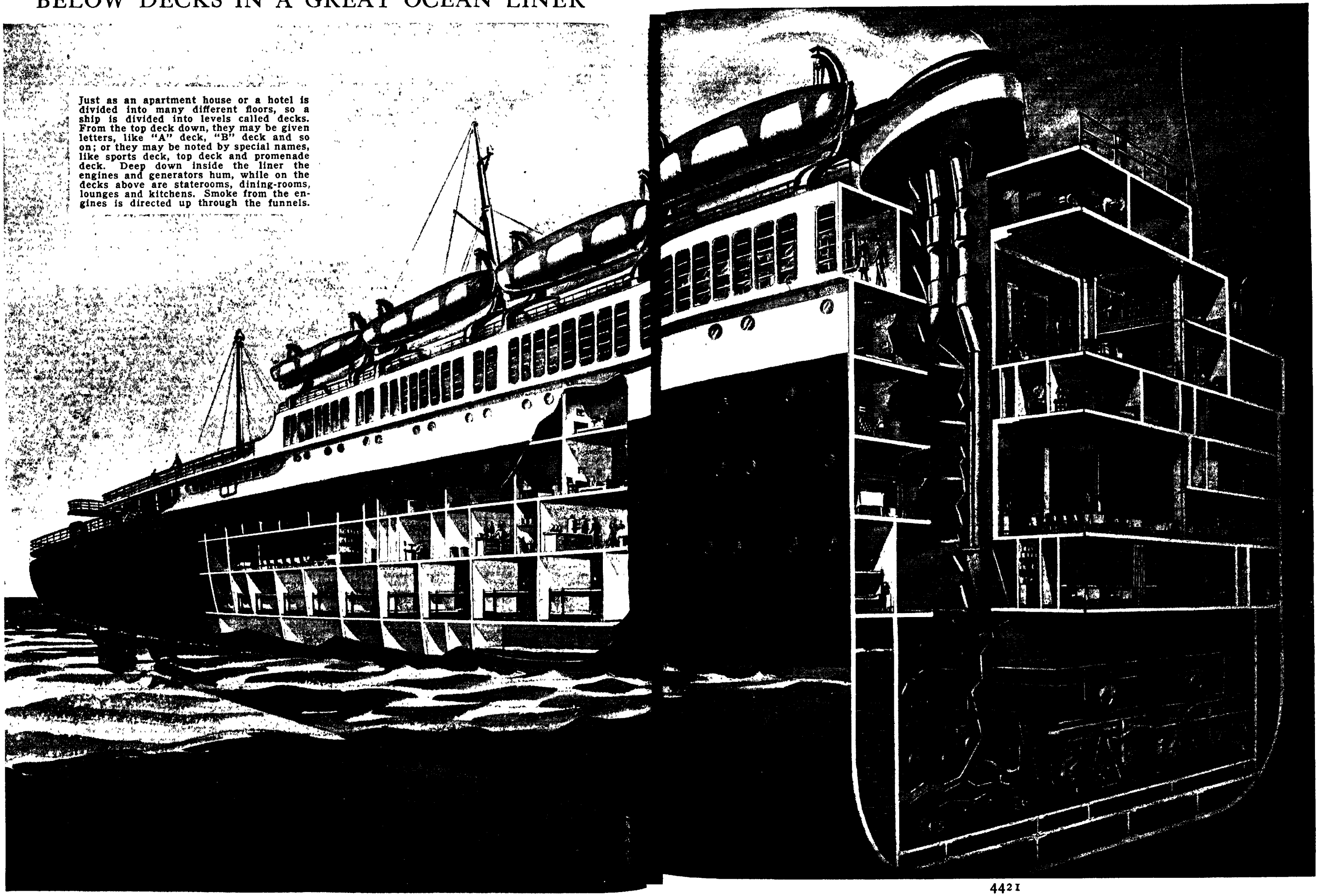
When you book passage for an ocean voyage, you are usually asked what class accommodations you would prefer. This means, simply, how do you want to live on your trip? Will you live first class (cabin class), the very best that the ship has to offer? Will you live tourist class, the next best? Or will you live third class, the most economical way?

The first-class staterooms will be bigger and more expensively furnished than the other two classes. If you are a first-class passenger, you will dine in the Main Dining Salon, or restaurant, which is usually the largest and most luxurious room on any ship. You will probably have a better choice of food, and your entertainment facilities will be greater. But all this will cost you more money, too.

Years ago ships had four different classes: first, second, third and steerage. Now, some

BELOW DECKS IN A GREAT OCEAN LINER

A FLOATING CITY HOUSES MANY PEOPLE



Just as an apartment house or a hotel is divided into many different floors, so a ship is divided into levels called decks. From the top deck down, they may be given letters, like "A" deck, "B" deck and so on; or they may be noted by special names, like sports deck, top deck and promenade deck. Deep down inside the liner the engines and generators hum, while on the decks above are staterooms, dining-rooms, lounges and kitchens. Smoke from the engines is directed up through the funnels.

ships, like the Queen Mary, have the three classes we mentioned; others have only two, first class and tourist; still others have only one class.

Extending up into the air from the Main Deck we have the crow's-nest. Sometimes people will try to fool new voyagers by telling them about the eggs in the crow's-nest. Actually, it is not a bird's living quarters at all, but a high point on a mast, from which a lookout may observe what lies ahead. In this ship it is electrically heated.

Looking out a porthole, or ship's window, as we walk down to A Deck, we can almost imagine the big vessel plowing through the water. A wake, or track of foam, trails the ship. Off the starboard bow we can see a school of fish jumping up and out of the water as they follow us along. They look like sharks, but every sea-going traveler knows that they are only hungry porpoises, waiting for scraps of food.

On A Deck we have staterooms, lounges and smoking-rooms. Here, too, we will find the office of one of the ship's most important men, the purser.

The job of the purser's department is to act as cashier and chief clerk of the ship. He is your banker and the crew's paymaster. If you should want to exchange some American dollars for British pounds, the purser is the man who will help you. He will store your valuables in his vault for safekeeping, or cash your checks.

Closely connected with the purser in attending to the comfort and convenience of the voyagers are the various stewards. By a steward we mean a person who is hired by the steamship company to help the passengers in any way possible, especially in regard to their rooms, their meals and their comforts on deck.

The dining-room steward helps the passengers obtain suitable seating arrangements and service. The room steward keeps your cabin neat and tidy, and your belongings in proper order. The deck steward is the man you see to obtain a deck chair (on shipboard almost everybody rents a reclining chair and a blanket (robe) to relax and rest in when on deck). He will also serve you bouillon on deck in the mid-morning and tea in the afternoon.

Courtesy, United States Lines

Deck chairs on the Promenade Deck are placed so that passengers can see the ocean through the big glass windows.

We could go far down inside the ship, stopping at each one of the many decks. You would be surprised to find that some of these decks are below the level of the ocean, or, as it is called, below the water line.

But suppose we just describe some of the other wonders on a passenger liner.

In case your father wants to take the family dog and automobile with you on the sea voyage, there is plenty of room for both.

A dog's life on board ship includes all

Doctors and medicines are available to help you in case you become ill.

Regular radio programs from American and European stations are picked up and distributed through thirty-eight loud speakers on shipboard. Passengers can choose from a variety of the best features on the air.

Throughout the day and night the wireless is constantly bringing in the news of the world. On smaller ships the news is posted on bulletin boards, but on larger liners daily newspapers are published, just as in your own town or city.

Ships at sea act as weather-observation posts, too, and by means of radio they exchange this information with the main weather offices on land. Since hundreds of ships co-operate in performing this useful task, the great number of reports that are collected make it possible for charts of weather conditions to be made. Much of our stormy weather begins at sea, so you can appreciate how important this information can be to other ships, to airplanes and to the main weather bureaus.

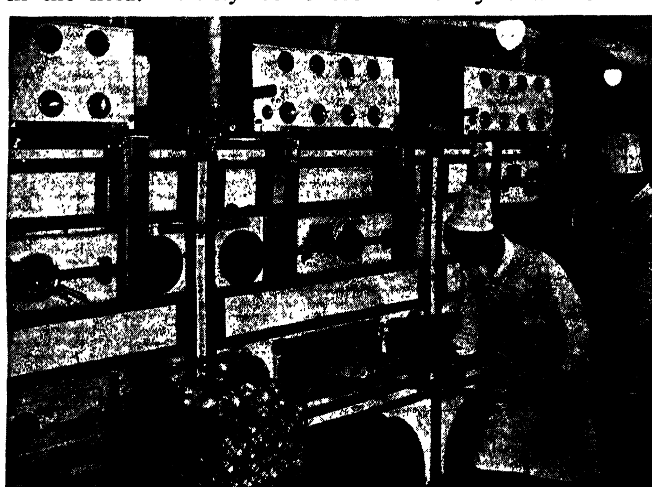
Electricity on board ship is used in an amazing number of ways. Of course, the first thing you will ask is, where does electricity come from when you are on the

the modern conveniences. He has his own beauty parlor, a shiny bath and a complete medicine chest. His diet and exercise are supervised by a trained expert. In fact, on one boat, the America, a menu of each dog's meals is printed every day for the inspection of his owner!

Automobiles are stored deep down in one of the ship's holds. This ocean-going garage takes good care of your car, fastening it securely so that no move of the ship will harm it by tossing it around in the hold.

Elsewhere on board we will find a modern moving-picture theater, where the latest productions are shown frequently and free of charge. Passengers use the ship's libraries, where you can find the latest books for young and old. There is a barber shop, a florist, a beauty salon for the ladies, a swimming pool and a real hospital with doctors and nurses. There are provisions for religious services, too.

Passengers on the Queen Mary can easily communicate by telephone or radio with any part of the civilized world. You can pick up a telephone and talk with friends in New York, Ottawa, London or Paris.



Pictures, courtesy, Cunard White Star Line

Bakers in the huge kitchens of the Queen Mary. They use most of the 280 barrels of flour which the ship carries on a normal round-trip voyage.

ocean? You can't get it from the electric company as you do at home. The answer is that the ship makes its own electricity. It is really a floating power-house, carrying many generators and motors.

Seven of the big generators on the Queen Mary deliver enough electricity to completely supply the needs of a city like Spokane, Washington; Des Moines, Iowa; Jacksonville, Florida, or Quebec, Canada.

Hundreds of electric motors of different sizes do everything from driving the ship and steering it to operating pumps, elevators and a ventilating system. On the Queen Mary there are 30,000 light bulbs. There is also an air-conditioning system, operated by electricity, to keep an even temperature and humidity in any kind of climate.

There is an automatic fire-alarm system on most modern liners. Flashing lights on large deck-by-deck diagrams of the entire ship indicate the least sign of trouble. The ship's firemen rush to the designated post just as fast as would your local fire department at home. Anywhere on the ship high-pressure mains, or pipes, are available to furnish fire-smothering water.

Another thing that helps provide fire protection is the division of the ship into various compartments, by the use of partitions, or bulkheads. Any one of these sections may be automatically cut off from the rest by closing the compartment doors electrically from the bridge. These sections are watertight, too. This means that if the ship runs aground, or if there is a collision, any water that comes in may be restricted to one location. Many compartments can be flooded, and the ship will still float.

The Queen Mary's modern electric kitchens enable more than 200 cooks and bakers to prepare huge quantities of food in the best and easiest way. Over 40,000 meals are served during a single trip.

Courtesy, United States Lines

A children's playroom on the S. S. America. It has a hobby horse, a blackboard, blocks and many other toys.

Back of the kitchen there are the storerooms and the refrigeration plant, filled with tons and tons of provisions. For a round trip the Queen Mary carries 60,000 eggs, 5 tons of hams and bacon, 50,000 pounds of potatoes and 2,000 quarts of ice cream! There is more refrigerator space on board than in 15,000 homes!

Getting fresh water is a problem on a ship at sea. If you can't carry all you need, then you have to find other means of getting it. Modern ships solve this by using what is known as an evaporator. It heats sea water until steam comes off, and then it collects the steam. When the steam is condensed (cooled) it is fresh water; the salts are left behind. The evaporator is costly to use, however, since it requires constant

Courtesy, United States Lines

The grand ballroom of the S. S. America, the largest passenger ship ever built in the United States. The painting on the wall in the background portrays the sea king, Neptune, driving four horses through dashing waves.

cleaning and repair. Therefore, most liners use tanks to carry fresh water from port to port. Most people like to use water from the ocean for their baths aboard ship. This is piped into the bathtubs and showers.

An ocean voyage provides relaxation and vacation fun. From the time you "hit the deck" (get up) in the morning till night, your day is full. Eight bells rings out as you begin a typical day on a modern passenger liner. You first close the stateroom porthole because that crisp sea air is a bit chilly this morning.

A needle-like salt-water shower washes the sleep out of your eyes, and it does not take you long to get dressed and out to the dining-saloon for breakfast. You are located at table thirty-two, second sitting. There are usually two and occasionally three sittings for shipboard meals. This means that

Courtesy, Cunard White Star Line

A picture of the shopping center on one of the greatest luxury liners that ever sailed the ocean, the Queen Mary. In these smart shops, passengers can buy almost anything they need during the few days of the swift voyage.

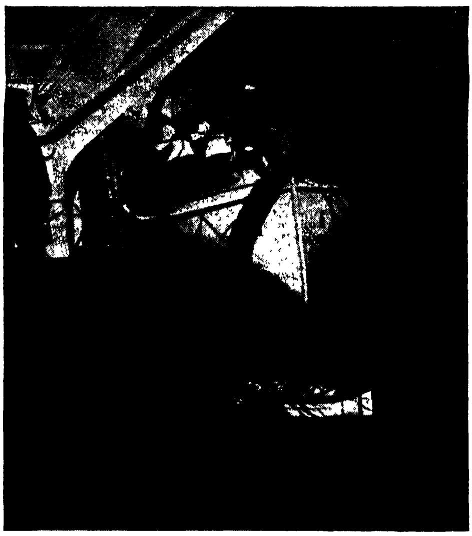
some people eat early and some later, because there aren't enough tables for all at once.

After breakfast, you take an elevator up to the Promenade Deck. The sea is smooth as glass today and the ship hardly pitches and rolls at all. (By pitch is meant the rise and fall of the bow and stern as the waves toss the ship. Roll means the port and starboard, or sideward, ups and downs).

It always helps digest one's food to walk after a meal, so you take a few turns around the deck. Some of the other folks are already playing shuffleboard and deck tennis on the Sports Deck.

The deck chair and robe look mighty good after the promenading, so you bundle up and sit watching the sea gulls swoop and sail through the air. A sailor always knows that where you find gulls, land is not far away.

It may be all right for mom and dad to rest in the deck chair all morning, but you decide to have a swim. This means you will probably miss the morning bouillon served by the deck steward, but that pool is very tempting, isn't it?



Lifeboat drills are held regularly on shipboard.

You go aft to the cabin for a bathing suit, and then forward and down to the pool. The dressing rooms are close by.

The water is just the right temperature. Of course, it is rather chilly outside, but the pool is heated, and the sun lamp is not far away. You are having so much fun that before you know it lunch time rolls around. And what a lunch! Golly, but you are hungry! It always seems that way on an ocean trip; you can never satisfy your appetite.

The ship's daily paper includes an announcement that there will be a lifeboat drill at three o'clock in the afternoon. The master of the vessel always schedules this drill on the first or second day of the voyage, so that everybody knows how to act should there be an emergency. Instructions are posted back of your stateroom door, telling where your life-jacket is stored (usually under your berth), how to put it on, the number of the lifeboat to which you are assigned and where it is.

A short while after lunch you join some other people on the Sports Deck in a game of deck tennis. This is a fast game played somewhat like ordinary tennis, except that no ball and no racket are used. Using only one hand, you throw a rope ring, like a quoit, back and forth across the net.

The huge whistle up by the funnel starts tooting away before long, and you realize that it is time for the lifeboat drill. A quick run down to the cabin for your life-jacket, and then you dash back up on deck to life-boat twenty-one. A short talk by a ship's officer on what to do and how to act in any emergency completes the drill.

As you go forward by the chart room, an item on the bulletin board catches your eye. The ship has traveled 609.6 miles since noon yesterday, averaging 25.4 knots. There is another interesting note. The barometer is falling and a storm is predicted. To a veteran seaman, a falling "glass" (the barometer) is almost a sure sign of bad weather to come.

You spend a while looking at a book in the comfortable library, and it isn't long before your stomach tells you that dinner time is near. The evening meal is usually the big meal of the day on shipboard.

After dinner you look forward to an evening of entertainment. One of the important new movies is going to be shown in the theater, and your folks decide that you will all attend. It is an enjoyable show.

The ship's bell tolls three times as you leave the theater. You know that means nine-thirty o'clock. It also seems to say, "Time for bed." The day has been full, hasn't it?

Sliding between clean, crisp sheets in your berth feels very good indeed. Sleep will come very easily tonight. And tomorrow is another day.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4503.


Tuskegee Institute
Booker T. Washington


S. Hurok
Marian Anderson.


The Crisis
Paul L. Dunbar.

SOME OUTSTANDING AMERICAN NEGROES

NEGROES are among America's oldest settlers. In George Washington's day, they numbered 750,000, one-fifth of the population. Today, Negroes form one-tenth of the nation, and that one-tenth now totals over 13,000,000 persons. But the American Negro's start, though early, was not a favorable one. Most of his African ancestors did not come to this continent as free settlers, but were brought as slaves against their will, and were employed as servants and workers chiefly in the southern colonies. There their labor helped to build up the great cotton, rice and sugar plantations of the South. We tell you about the slavery question, which almost split the country in two, in the story of the United States. In this article we shall tell you of some Negro men and women who have achieved greatness against unusual odds —and the greatest of these odds was, of course, slavery itself.

Some few Negroes never were slaves; others were able to buy their freedom by extra work, others succeeded in running away from their owners, still others were freed by their masters. By 1860, nearly 500,000 were free. But eight times that number were still in slavery. Since 1865, the year of the Thirteenth Amendment to the Constitution, all have been legally free. So that date marks the great turning point in the story of the Negro.

We can best follow the Negro's history by taking 1865 as an observation point, looking back a hundred years to colonial days and the Revolutionary War, and then looking forward nearly a hundred years, up to the present day. The period looking back from 1865 was one of hardship, injustice and hopelessness, because of slavery. The period looking forward after the Civil War has also been a period of hard struggle, but one of inspiration and hope as the struggle leads successfully up from slavery to freedom, citizenship, achievement and equality. Each of these periods has had its heroes, some of whose life stories we tell you now.

What held Negroes back all during the period of slavery was not so much lack of ability as lack of education and opportunity. This is proved by what a few Negroes were able to accomplish when opportunity did come their way. There were quite a number of such outstanding Negroes, even from the earliest days of America's settlement. In fact, a few Negroes aided in the early discoveries and explorations. One Spanish Negro, Nuflo de Olano, accompanied Balboa in 1513 when he discovered the Pacific Ocean. In 1527, another Spanish Negro, Estavanico, was the chief scout of the expedition of Narvaez, which explored the region now New Mexico and Arizona. The Spaniards and Portuguese, even though they dealt in slavery, did not deny education or opportunity to intelligent, ambitious Negroes.

Other groups of colonial settlers did not follow this example until much later, and

then only in certain cases. They knew that ignorance was the best weapon for keeping Negroes in slavery. Frederick Douglass, who was born a slave, but ran away to become a great anti-slavery leader after he became educated, used to say: "Chains can put a man in slavery, but only ignorance can keep him there."

For example, a frail little slave girl arrived in Boston Harbor from Africa, and was bought by a well-to-do merchant named Wheatley as a maid for his wife. She took the name of Phillis Wheatley. The Wheatleys taught her to read and write when they saw how intelligent she was. Soon she surprised them by writing poetry. Further encouraged, she became a talented poetess and one of the celebrities of her day. In 1767 she wrote a poem on colonial liberty addressed to the students of Harvard College, and in 1775, a poem congratulating General George Washington on his assuming command of the Revolutionary armies. Phillis was sent to England where she was entertained in London literary circles and at court. She published five books of verse before her death in 1794.

In the days of the Revolution many Negroes in New England were active friends of colonial freedom. They saw the connection between freedom for the colonies and freedom for the slaves. One such, a well-educated minister named Lemuel Haynes, was a minuteman and Revolutionary soldier. He published sermons on the cause of colonial liberty as well as against slavery. Another Negro, Crispus Attucks, led a small band of Boston patriots who defied some British soldiers. They fired and Attucks was the first to fall in what we now know as the Boston Massacre. This was the first skirmish of the Revolutionary War; so his was the first blood shed for American freedom. A monument dedicated to Attucks and the four white comrades who died on March 5, 1770, now stands on Boston Common.

Peter Salem, another colonial Negro, distinguished himself in the Battle of Bunker Hill. So also did Salem Poore near the end of the war in the Battle of Charleston, South Carolina. In all, 6,000 Negro soldiers fought for American freedom in the Continental armies. Many Negro sailors also fought in the War of 1812. They were particularly brave in the famous Battle of Lake Erie under Commodore Perry.

Yale University Art Gallery

Peter Salem at the Battle of Bunker Hill.

In the slave states, too, some remarkably talented Negroes achieved fame. Joshua Johnston, a Negro portrait painter, was one of the leading artists in Baltimore around 1800. Another Maryland Negro, Benjamin Banneker, became famous as an inventor, astronomer and mathematician. He fashioned of hand-carved wood the first mechanical clock made in America. From 1792 on he published one of the best Almanacs available at that time. It attracted the attention of Benjamin Franklin and Thomas Jefferson. The latter became Banneker's friend and patron, and had him appointed as surveyor on the commission which laid out the nation's capital, Washington, D. C.

But such exceptions made little difference in the lot of the great mass of Negroes held in slavery and ignorance. As the cotton

trade grew, their condition became worse. Many groups of slaves revolted, hoping to win freedom; but, lacking arms and training, they were not successful. Several revolts, though, did cause the slaveholders great anxiety, especially one led by Denmark Vesey in South Carolina in 1822, and Nat Turner's Rebellion in Virginia in 1831. Vesey's revolt was inspired by the one successful slave rebellion, which took place in the French West Indies. This was led by Toussaint L'Ouverture, in Haiti in 1791. Toussaint successfully fought the British, the Spanish and finally an expedition of Napoleon's troops for control of the island. Though Napoleon in the end tricked him into exile, Toussaint had carried Haitian independence to a point where his successors, Christophe and Desalines, were able to make Haiti an independent Negro republic; and it remains so today. We tell you more about Toussaint elsewhere; see the Index.


Frederick Douglass, who wrote and lectured against slavery.

Under the circumstances, the main struggle for the Negro's release from slavery had to be carried on by white leaders of the Abolition movement, such as William Lloyd Garrison, Charles Sumner, Lucretia Mott, Henry Ward Beecher and his sister, Harriet Beecher Stowe, who wrote UNCLE TOM'S CABIN. But many Negroes also took part in the fight. Some were educated free Negroes of the North who knew the full benefits of freedom. Such a one was Martin R. Delaney, who in 1851 wrote a defense of the Negro's capabilities. Other Negroes who helped were William Still, for twenty-five years secretary of the Philadelphia branch of the "underground railroad" for rescuing runaway slaves; Samuel Ward, one of the most forceful anti-slavery orators; and William Wells Brown, who published the first novel written by a Negro, in 1853, while on an anti-slavery lecture tour in England. Others were ex-slaves, who after their escape, learned to read, write, speak and organize for the freedom of their fellows. Notable among these were two famous Negro women, Harriet Tubman and Sojourner Truth.

Sojourner made helpful anti-slavery tours all over the North and the Midwest, often defying hostile mobs. She was a friend of John Brown, who tried to end slavery by his famous but unsuccessful armed rebellion at Harper's Ferry in 1859. Harriet Tubman became free by escaping to Canada. But so brave was she that for years afterward she continued to go down into the heart of the South to lead other bands of escaping slaves. With many rewards offered for her capture, she was never caught, but lived to a ripe old age after the war, in Auburn, New York.

The greatest of the ex-slave leaders was Frederick Douglass. Born a slave in Maryland about 1817, he fled north disguised as a sailor and reached New Bedford, Massachusetts. There he studied and became one of the most useful speakers and writers in the campaign against slavery. He edited an anti-slavery paper in Rochester, New York, which he called THE NORTH STAR, since that star guided many an escaping slave. Later he went on anti-slavery lecture tours to England, Ireland and France. He became a symbol of what a slave could rise to with talent and opportunity. When the Civil War broke out, Douglass helped persuade Abraham Lincoln to allow Negro troops to enlist. In all, 187,000 Negroes fought on the side of the North for "freedom and the Union"; and 80,000 gave their lives. So, as Douglass often said: "The Negro wasn't just given his freedom; he paid in his share


Harriet Tubman led bands of escaping slaves by "underground railroad" to freedom.

Hamp[illegible]

One of Henry O. Tanner's most famous paintings, the touching Ban[illegible]

for it." Just after the war, Douglass and a few other Negro leaders became very prominent in national politics because of the part they had played in the slavery fight. Some became members of Congress, two became senators. Douglass himself held many posts, among them United States Minister to Haiti, Recorder of Deeds in Washington and Marshal of the District of Columbia. He wrote his famous autobiography—LIFE AND TIMES OF FREDERICK DOUGLASS—and lived till 1895 to see and take part in the next struggle upward which the Negro people faced after their liberation — the struggle for equal opportunity and respect.

Even when freedom came, the freedmen faced a long, hard struggle. They were without education, property or experience in self-help. Education was their first need. It was first started by Northern missionary friends of the Negro who saw that it would be a long time before the states and communities of the South would give the Negro good education at public expense. There had to be education to make the ordinary folk able to read, write and have trade skills. There also had to be the best college training to provide teachers, doctors, lawyers, scholars and public leaders.

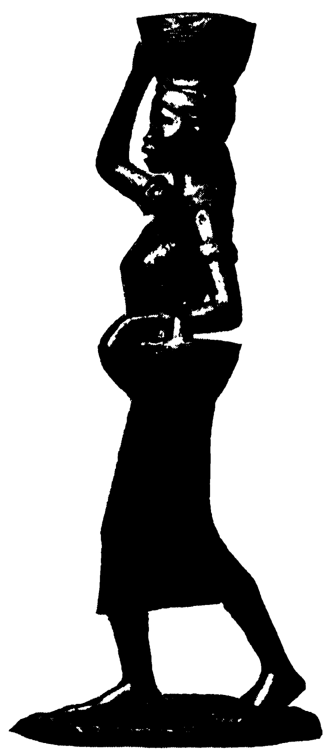
Whereas in 1870 only 5 per cent of Negroes could read and write, today nearly 90 per cent can do so. Where there was but a few highly educated Negroes, today there [illegible] over 55,000 col[illegible] graduates. Where there used [illegible] than a half dozen colleges for [illegible]; today, in addition to many [illegible] graduates of the best gener[illegible] and universities, there are m[illegible] 40 Negro colleges, and more th[illegible]o Negroes are enrolled in colleg[illegible] professional schools.

Following the Negr[illegible]ational advancement, progress to[illegible] along other lines—in home and [illegible]nership, in business and skilled e[illegible]nt, in arts and letters, especially [illegible]ic and the stage, in self-leadership [illegible]up welfare,

in contributions to scholarship, science and invention. It would take a book to detail the Negro's progress along these various lines in the years since 1865, but a general idea can be had from typical examples.

Booker T. Washington became the successful champion of practical education for the masses. Born in 1856, he could remember being taken by his mother, a plantation cook in Virginia, to hear the Emancipation Proclamation read at the "big house." That was why he called his autobiography UP FROM SLAVERY. As a grown lad, he walked 300 miles to Hampton Institute and worked his way through that school. On graduation, he was sent to take charge of a run-down farm school in Tuskegee, Alabama. He laid down a system of part-time work and study by which students built up the school as a model community. Its success attracted the attention of educators the world over, and not only won great support from Northern friends but won over many Southerners to the value of educating the Negro. By the time Booker Washington died in 1915, Tuskegee Institute was a vocational college teaching the skilled trades and scientific agriculture. It had thousands of students and graduates, and was worth millions of dollars in its buildings and endowment. His general plan also has become a standard pattern for state schools maintained at public expense by southern states for the education of Negro youth. It is practical education.

But progressive Negroes could not afford to be satisfied with just this one practical type of education: college and university training was also needed for leaders. The champion of this movement was William Edward Burghardt Du Bois (1868-), who, after training at Harvard and abroad, began teaching social studies at Atlanta University. His motto was "equal rights and equal opportunity," and he challenged Booker Washington's plan as the "half-a-loaf" program. Southern opinion sided with Washington, but Du Bois bravely left the South in 1910 to go to New York. There he helped to found an equal-rights organization, and became editor of its magazine, THE CRISIS. Since then he has continuously written, lectured, taught and traveled in behalf of Negro rights and for the recognition of Negro achievement. Today, in his old age, he has had the satisfaction of seeing his viewpoint largely accepted by progressive American opinion. In 1943, he was the first Negro to be elected to membership in The National Institute of Arts and Letters; and (as a State Department consultant) at the San Francisco Conference for World Organization, he was the leading spokesman for fuller rights and justice for African and colonial peoples.



Whitney Museum of American Art

One of the best modern sculptors is a Negro, Richmond Barthé. This bronze figure is an example of his work.

One of the fields in which the Negro has achieved exceptional success has been that of creative art, especially poetry and music. The first Negro poet to attain general recognition was Paul Lawrence Dunbar (1872-1906), sometimes called "the elevator-boy poet." This was because he wrote his first poems while working as an elevator boy in his home town of Dayton, Ohio. In a short time he became one of the most widely read poets in America. He died at the early age of thirty-four, but left a permanent place for himself, especially in his dialect portrayals of Negro life and character.

Following Paul Dunbar, there has been a notable succession of Negro poets: James Weldon Johnson (1871-1938), whose chief poetic work is a series of Negro sermons in verse, called GOD'S TROMBONES; Countee Cullen (1903-), who became known as one of the leading American poets even before he had finished college; and Langston Hughes (1902-), author of THE WEARY BLUES and many other volumes of verse and prose. His distinctive contribution is the use of the rhythms and folk-ideas of the ordinary man in the street or the backwoods.

The leading Negro writer of today, however, is a novelist and dramatist, although he began his career as a poet. He is Richard Wright (1908-), whose novel NATIVE SON and autobiography BLACK BOY have been best sellers and have provoked much discussion because of their bold, challenging descriptions of the handicaps the average Negro faces today in American society.

But it is in music that the Negro has had his earliest and his greatest triumphs. From the days of the great religious slave-song spirituals, the Negro has produced unique and characteristic music. American musicians, both serious and popular, have gradually learned to use the Negro rhythms and harmonies, until now the Negro type is generally considered the most truly American music. In serious music the Bohemian composer Anton Dvořák, assisted by the Negro musician, Harry T. Burleigh, used melodies from Negro spirituals as the basis of his NEW WORLD symphony. Since 1912, led by the popularity of the ST. LOUIS BLUES, introduced by the Negro musician William C. Handy, blues, ragtime and jazz rhythms and harmonies have become the main ingredients of our popular dance and song music. Yet Burleigh was hardly mentioned in Dvořák's success, and Handy sold the rights of the ST. LOUIS BLUES for a mere $100.

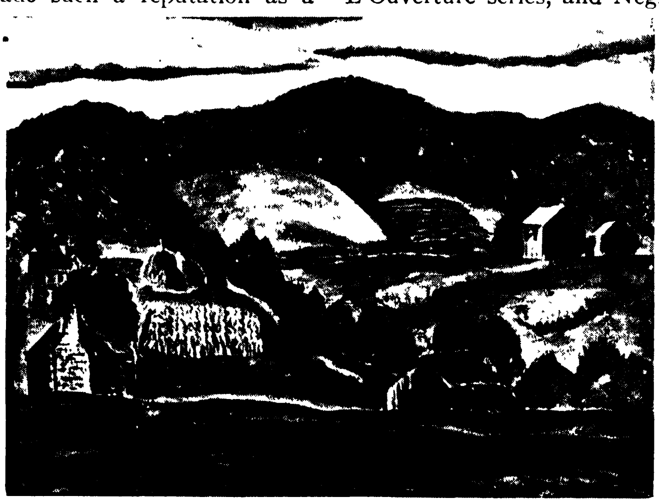
Later Negro musicians have reaped a rich harvest. Roland Hayes (1887-), impatient with color-line handicaps, went to Europe and made such a reputation as a concert tenor that the general American public was curious to hear him. His success in concert tours all over America broke a new path for Negro musicians, and made possible the successful careers of Marian Anderson, Paul Robeson and others. Miss Anderson (1902-), regarded by many as the leading American contralto, is a great-souled woman. In 1941 she was awarded the Edward Bok Prize of $10,000, given annually to the Philadelphian who has done most to aid or honor the city. Miss Anderson gave the prize money to a scholarship fund for promising young Negro musicians. Each year her concerts bring this famous singer a gross income of about $265,000. More than 250,000 copies of her recording of Schubert's AVE MARIA have been sold.

Paul Robeson (1898-) has had almost equal eminence as a concert singer and as an actor. His playing of Othello was one of the grandest versions of this tragic Shakespearean part.

Less known, but important, are such musical careers as those of William Grant Still, Negro symphonic composer; of Dean Dixon, orchestra conductor; of dancers like Katherine Dunham and Pearl Primus, of many younger singers and musicians not fully in their prime as yet.

Coming to be known more widely is the work of Negro painters and sculptors—a field that until recently had only a few representatives, like Henry O. Tanner and Meta Warrick Fuller, both of whom were better known in Paris where they worked and studied. Today there are many Negro artists. Among them are Richmond Barthé, sculptor, and Jacob Lawrence, a highly original painter who specializes in paintings depicting Negro history, like his Toussaint L'Ouverture series, and Negro social conditions, like his Harlem and Negro Migration series.

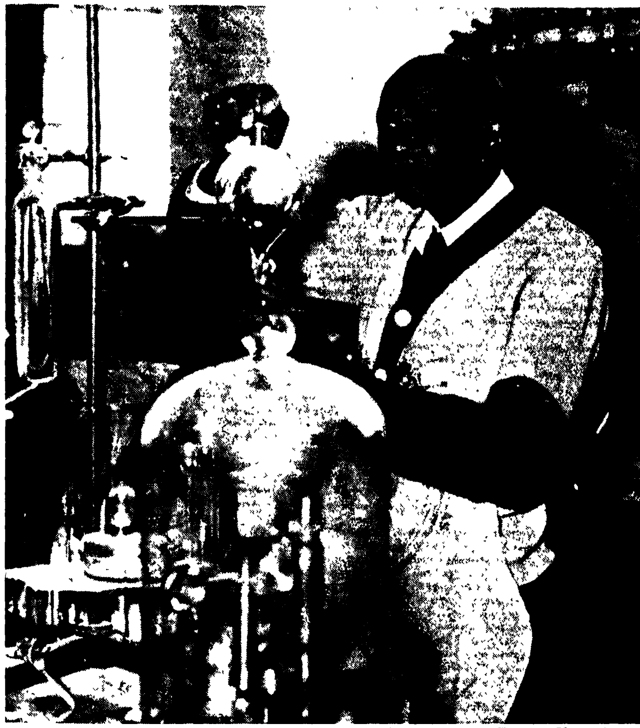
Owing to lack of capital and industrial control, opportunities have until recently been extremely limited for Negro development in technical and industrial lines. We have but to mention Jan Matzeliger's invention of



Marjorie Griffiths, courtesy of the Harmon Foundation

Many Negroes have turned to art as a profession and have become well known. This Southern landscape was painted by Malvin C. Johnson.

the lasting-machine, basis of mass production in the shoe industry; Norbert Rillieux's invention of the evaporating pan for the manufacture of sugar from cane; or Elijah McCoy's patented invention of the mechanical lubricating cup for machinery. All these important basic inventions were the work of Negroes, but the inventors lacked capital to develop them. So, until recently, Negro technical genius achieved its notable results in scientific research. Examples of such achievement are: Daniel Williams, Charles Drew, Ernest Just and George Washington Carver. Doctor Williams, of Washington, D. C., was the first surgeon to successfully perform direct surgery on the human heart. Doctor Drew, as a director of work in blood banks in 1941, developed methods by which blood plasma could be safely shipped over long distances. Ernest Everett Just was a biologist known and respected by scientists the world over. He was an authority on fertilization in marine life.



George Washington Carver Foundation

George Washington Carver, famous Negro scientist. He died in 1943.

Best known of all Negro scientists, of course, is the fascinating figure of George Washington Carver (?1864-1943), pioneer in soil and crop chemistry. He is to be credited with many important discoveries which he gave to the public, either directly or through the United States Bureau of Agriculture. Among them was the use of the peanut as a substitute crop in the crisis of the boll-weevil plague in the cotton belt. (The peanut became the second Southern cash crop by 1940.) Carver developed scores of technical chemical by-products of the peanut and the sweet potato. He was awarded the Theodore Roosevelt Medal, the honorary degree of Doctor of Science of the University of Rochester, the Thomas A. Edison Foundation Award, the Spingarn Medal and other honors.

For further details of Negro achievement, read: 13 AGAINST THE ODDS by Edwin R. Embree, 1944; CHILD'S STORY OF THE NEGRO by Jane D. Shakelford, 1938; FOR FREEDOM by Arthur Fauset, 1934; WE SING AMERICA by Marion Cuthbert, 1936; RAILROAD TO FREEDOM by Hildegarde Swift, 1932; BIG BEN (based on Robeson's youth) by Earl S. Miers, 1942; GIFT OF BLACK FOLK by W. E. B. DuBois; THE NEGRO IN SPORTS by Edwin B. Henderson, 1939; THE NEGRO GENIUS by Benjamin Brawley, 1937; THE NEGRO IN ART by Alain Locke, 1941. For individual biographies: HARRIET TUBMAN by Earl Conrad, 1943; SOJOURNER TRUTH by Arthur Fauset, 1936; LIFE AND TIMES OF FREDERICK DOUGLASS, autobiography—reprinted in 1940; UP FROM SLAVERY, autobiography of Booker T. Washington, 1917; ALONG THIS WAY by James Weldon Johnson, 1933; ANGEL MO' AND HER SON: ROLAND HAYES by MacKinley Helm, 1942; FATHER OF THE BLUES by W. C. Handy, 1941; GEORGE WASHINGTON CARVER by Rackham Holt, 1943; MARIAN ANDERSON by Kosti Vehanen, 1941; CITIZEN TOUSSAINT by Ralph Korngold, 1944. Most of these books you can find in your public library.

By ALAIN LOCKE.

THE NEXT STORY OF MEN AND WOMEN IS ON PAGE 4582.

U. S. Department of Agriculture

The eatable part of the chestnut, with its delicate flavor, is doubly protected, first of all by the satiny shell of the nut, and then by the sharp, prickly outer jacket, or burr, which surrounds the clustered nuts.

The NATURAL HISTORY *of a* NUT

WHAT is a nut? It is among the most valuable of all the fruits we eat. When the fruit of a tree or a shrub is inclosed in a bony, woody or leathery covering that does not open when ripe, it is commonly called a nut. Some people, indeed, live almost entirely on nuts.

Nuts differ very much in their formation, and fruits like the walnut and chestnut, which have a thick outer covering that has to be removed before what we call the nutshell is exposed, are really at a stage between a stone fruit, like the plum, and a nut that has its shell exposed, like the filbert.

Of the commercial "nuts" one of the most curious is the almond. The almond tree is really a near relative of the peach and nectarine, but the fruit, instead of having an outer covering of delicious pulp which develops and sweetens, has a covering that shrivels as the fruit ripens; and when the ripening process is complete, it has become a horny kind of husk that splits open and frees the pit, or seed, which is what we call the nut. It is not a true nut. Two kinds of almond are grown, the sweet and the bitter. The sweet one is used for dessert on account of its rich and pleasant flavor, and the bitter one provides a flavoring extract. When the oil has been distilled from the bitter almond it contains prussic acid, from which it has to be freed before it can be used with safety for cooking purposes.

The almond tree is very beautiful, one of the first to blossom in spring, and there is no more cheerful prophet of coming summer than this tree, bare of leaves, but clothed in a glorious mantle of pink blossom. In certain climates it does not have fruit; and where it does, there is a good deal of difference in the texture of the shells. The writer has in his garden an almond tree that bears nuts the shells of which are so hard that they need a hammer to break them. On the other hand, by careful selection of those seeds with comparatively thin shells and by constantly breeding from them, men have produced a type of almond which yields nuts with shells so soft that they can be broken with the fingers. This type of plant is known as the paper-shelled almond.

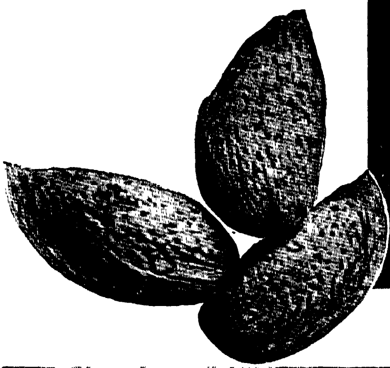
Almonds are grown extensively in western Asia, France, Spain, Italy, northern Africa and California. When the nuts are ripe and the hulls have split open, the branches of the trees are shaken or jarred, and the fruit drops on to canvas sheets laid on the ground. The nuts are freed of their hulls, then dried and bleached by sulfur fumes. It is therefore a mistake to suppose that almonds with bright yellow shells are necessarily the best.

Another great favorite is the Persian (English) walnut, originally brought into Eng-

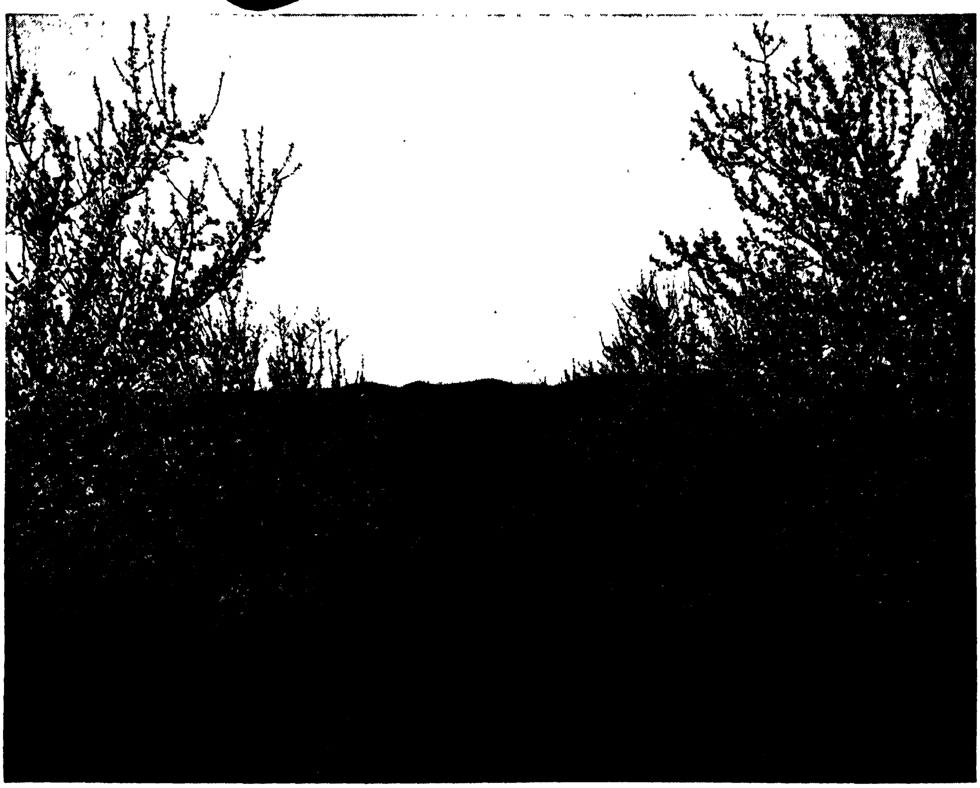
THE GLORY OF THE ALMOND TREE

To the right is a branch of the almond tree, with its thickly clustered, sweet-scented pink blossoms. The leaves of the almond tree do not come out until the blossoms have faded and the seeds, or nuts, have begun to form.

Pictures from California Almond Growers Exchange



To the left are the almonds, all ready to be shelled and eaten.



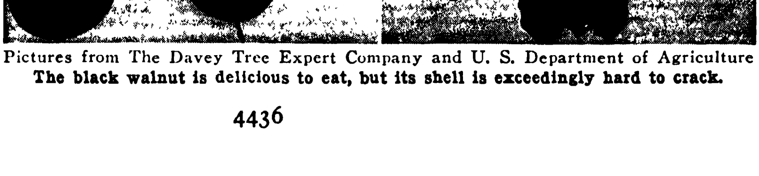
The almond tree has been cultivated in many parts of the world. This blossoming orchard is in California.

U.S.D.A.
Shagbark hickory nuts.

land by the Romans. It is a native of Greece and of southern Asia. The tree is very handsome, with graceful branches, and the warm hue of the leaves in spring adds a pleasing touch of contrast to the foliage of other trees. The flowers begin to open in April, and are in full bloom by the middle of May. The wood of the trees is very valuable, the beautiful grain making it popular with cabinetmakers. It is the best timber for gunstocks, and so important was the wood from this point of view that, in several European countries in the seventeenth century, before a man could marry he had to produce a certificate showing that he had planted a certain number of walnut trees. This may have seemed a hard law at the time, but the plantations eventually enriched many of the planters. The tree grows rapidly, and the age at which it is usually cut for its timber is fifty or sixty years.

When the fruit first forms, the shell inside is soft and the fruit, in its green outer case, is gathered for pickling. Later the shell inside hardens and the corrugated kernel becomes sweet and crisp. About half the weight of the kernel is oil, and the walnut oil pressed out from the kernel is used for a variety of purposes. The tree can be raised from seed or it can be propagated by budding or layers. The walnut flourishes in any fertile soil so long as the subsoil is dry and the position a little sheltered. The biggest and finest nuts are produced in California and in southern Europe, but the nuts are also grown elsewhere, in southern England, for instance, in China and in South America.

Several other species of walnut are grown in America. One of these is the butternut, a large, handsome tree. The nut is long and pointed, and from its clammy green husk good housewives in olden times obtained the stain with which they dyed their homespun woolen garments. A palatable sauce is made from the nuts when they are green, and the ripe nuts are much liked.



Pictures from The Davey Tree Expert Company and U. S. Department of Agriculture
The black walnut is delicious to eat, but its shell is exceedingly hard to crack.

The eastern black walnut, an American tree, has been introduced into Europe. It has an outer cover much rougher and rounder than that of the common walnut. The kernel is sweet, but the shell is exceedingly hard. Boys break them with a hammer, and squirrels have to gnaw vigorously to get through them. Butternuts also have to be cracked with a hammer, and it is difficult to get the nuts out whole. The wood, like that of the European walnut, is much valued for gunstocks, and for cabinetwork of various kinds.

A favorite nut in America is the hickory. There are several species, all natives of North America. Generally they grow wild, but experts are now beginning to give their attention to the hickory, and trees are being improved by cultivation and selection. The Indian formerly used the nuts as a leading article of his diet and collected large quantities to store for the winter, and the early settlers followed his example. Imitating the Indian squaws, the white settlers used to pound the nuts, shells and kernels together in a mortar, and after boiling them in water, they strained out the hickory milk, to which they added corn meal, and from the product baked cakes on hot stones or in ovens. Hickory wood is one of the strongest and toughest known. It is used for wheels, tool handles and other things where strength and elasticity are needed.

Another American nut allied to the hickory is the pecan, and large plantations of it exist to supply the commercial demand. It grows in southern United States, and when allowed, the trees grow to a great height. The wood is used for a number of purposes. Both hickory and pecan are members of the walnut family.

The "European" chestnut is, in fact, a

native of Asia Minor and Greece. It grows to a great size and is a very fine tree, towering to a height of eighty or a hundred feet. Some trees are believed to have lived for more than five hundred years. The leaves are large and lance-shaped with saw-like edges, and the flowers hang in long yellow catkins. The fruit is contained within a strong skin or leathery coat, and this is surrounded by a second coat, a kind of overcoat, covered with spines. When the nuts are ripe, the burr opens and allows them to fall.

The tree begins to bear in about twenty-five years, and its timber is at its best from that age to fifty or sixty. The bark is very distinctive, for though when the tree is young this is smooth and brown, as time goes on it becomes gray and the surface splits. The chestnut keeps its leaves till late autumn, when they become a golden yellow, and in France these are often used as stuffing for mattresses or litter for cattle.

The American chestnut is much like the European, but the nuts are not so large. In our century a deadly fungus has destroyed thousands of fine chestnut trees. For some time no remedy could be found, but lately some trees have been saved. The chinkapin (or chinquapin) is a chestnut found in the southeastern United States. It bears only one nut in a burr.

The filbert bears an excellent-tasting nut. The plant rarely attains the dimensions of a tree, but is generally a shrub, growing in hedgerows and among the undergrowth of woods and coppices. It flourishes even at a height of fifteen hundred feet above sea level.

THE FILBERT IS A HERALD OF THE SPRING

The filbert, a relative of the oak, beech, birch, alder and chestnut, is a straggling bush, with long stems rising directly from the root, and the leaves are rounded and pointed, with a saw-like edge. The male flowers, which hang in yellow catkins, appear before the leaves, and are, indeed, among the earliest harbingers of spring. The female flowers, are not easy to see. They appear as pinkish threads, clustered together at the tips of the buds near the ends of one-year shoots.

The leaves remain on the filbert until almost every other tree is bare. The bright yellow color in autumn gives a lovely touch of color to the countryside. The tree is not bare even after it has lost its leaves, for the catkins then expand and remain all winter.

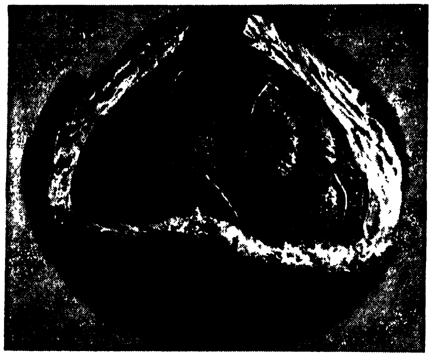
Courtesy, U. S. Department of Agriculture
The Persian, or English, walnut has very fine wood.

The beech, although a fine tree, is scarcely worthy to be classed among our nut trees, for its fruit is small, consisting of two tri-angular-pointed nuts in a seed-vessel which opens in four valves and is covered with blunt prickles. Beechnuts make excellent feed for swine, sheep, poultry and wild life.

Cashew nuts are kidney-shaped in a thin shell, and are borne on flesh-colored stalks that look something like fruits. They grow in the West Indies and tropical America. The nuts are eaten roasted in oil or salted like almonds. We import many cashews from India and Africa.

Pistachio nuts are the seeds of a tree of the cashew family (related to our sumac) which grows in northern Africa and southern Europe. The nuts are small and have a bony-like but thin skin, and pale green kernels: They are eaten in large quantities in India. In Europe and America they are used for flavoring as well as for eating. You have all tasted the pale green pistachio ice cream.

One of the most extraordinary nuts in the world is the Brazil nut of South America, which grows on a tree from 100 to 120 feet high. The nuts as we buy them are shaped like the sections of an orange. They are in reality seeds and not true fruits like chestnuts, walnuts and the other nuts we have mentioned. They are contained in a woody



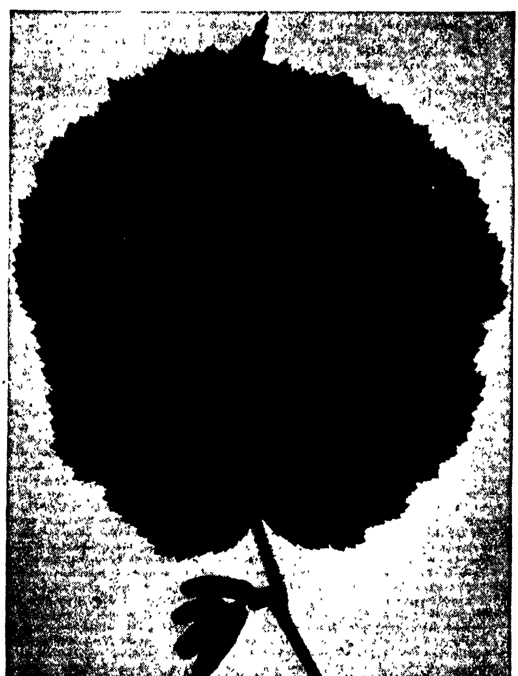
How Brazil nuts grow, a number of them tucked away in a hard wooden outer seed-vessel.

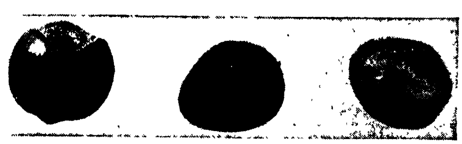
seed-vessel so heavy that, if one fell from 70 or 80 feet upon the head of a person walking or standing beneath, it would probably kill him. The natives of the Brazilian forest, when walking in the neighborhood of the trees at the time the nuts ripen, cover their shoulders and heads with a strong buckler of wood.

Inside this wooden seed-vessel are four divisions, and in each of those divisions lies a number of the triangular nuts that we know. The whole fruit is a truly marvelous production. It usually takes a year for the fruits to develop from flowers, ripen and drop. The outer wooden case is at least half an inch thick and is difficult to open even with the sharpest instrument. The nuts contain as much as 56 per cent oil, and this is pressed out by the natives and often used for lighting purposes. It is also exported in large quantities. If we cut a Brazil nut flat at one end and sharpen the other end to a point, like a wick, we can stand the nut on a plate, light the wick and see it burn brightly enough to lighten a room. This will give us an idea of how much oil it contains. The Brazil nut is sometimes called the juvia.

The most useful of all the nuts that grow is the coconut. Its uses are legion, and it is impossible to suggest even a tenth of them here. Among them are brushes, clothes, mats, nets, rope, paper, quilts, hats, sails and torches, all made from the fiber; fuel, oars, huts, yokes and knife handles are made from the timber; the hard shells are used for drinking-vessels; a drink is made from the so-called milk; the white nut part is eaten as it is and shredded for use in confectionery and cakes; and from the oil we make oleomargarine, soap, candles and lubricating oil. The dried meat is also used as a food for cattle.

These are only a few of the uses of coconut, and there seems no limit to their multiplication. Even ink and gum can be made





At the top is a cluster of hazel twigs with the nuts growing on them; and below are ripe hazelnuts, or filberts, as they are most often called.

The ragged-looking leaf of the shrub-like tree from which our filberts, or hazlenuts, come. This is one of many species of the genus "Corylus."
Pictures courtesy, U. S. Department of Agriculture

THE PECAN TREE OF THE SOUTHLAND

Courtesy, U. S. Department of Agriculture

The graceful pecan tree of the southern United States. Above are a spray of blossoms and a cluster of the nuts.

from this universal provider among the plants. It has been said that a man could live and clothe and house himself on the coconut.

The coconut-palm loves the sea air, and flourishes best on the shelly soil of a tropical shore. It commonly grows leaning toward the water, and with its crown of leaves and clustered nuts it is a very picturesque tree. But it is the fruit which is so wonderful. It is the most richly stored seed of all known plants and is protected in a most ingenious manner. The nut as we see it in the shop is not the complete fruit. Part of its covering has been removed.

Deep inside is the kernel, a single seed, from which a young coconut tree may grow. It has round it the white fleshy meat that we eat, which is really food stored up for the use of the kernel when it begins to grow. There is also a quantity of fluid called milk, which is to supply moisture to the kernel when it is developing in the shell. Next to these soft inner parts of each coconut comes the hard shell which we know so well. But Nature decided that even this was not sufficient protection for the coconut. The nut may hang many feet from the ground, and when it falls it might get cracked, so outside the hard shell is a great mass of fiber which acts like a thick, springy blanket and breaks the fall and saves the shell from damage. Outside all this is another green covering.

There is another wonder about the coconut. If we look at one we shall see at the blunt end three round spots, and if we take a sharp penknife and try to cut into them we find that two are quite hard and difficult to penetrate, while the third is softer. We think of this soft hole as the hole that lets out the milk, and that, of course, is a great convenience, but it is in reality the hole that lets out the young coconut tree which sprouts from the kernel inside.

But why are there three holes? The coconut belongs to a family of plants whose seeds are arranged in threes, and at one time the ancestors of the coconut undoubtedly produced its seeds in threes. Now, however, it produces only one seed. The other two have disappeared, but there still remain traces of the holes by which the sprouts of the other two germs used to emerge from the shell. Now that there is nothing to come out of them, they have become covered with hard shell.

If we can see a coconut as it comes from the tree with the covering of fiber on it and the outermost case, we shall notice that it is more or less triangular in shape. This is thought by some to be a survival from the time when the nut produced three seeds in three compartments.

The coconut tree is widely distributed on tropical shores. It is commonly believed that the nuts often fall into the sea and are carried by the waters to other lands, where they are thrown up and often sprout and grow into trees. Recent studies by scientists, however, cast much doubt upon the truth of this belief. The tree begins to bear fruit when it is eight years old, and it goes on producing for eighty years. It may produce one hundred coconuts a year.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 4507.

Courtesy, General Foods Corporation

Food, clothing and shelter are obtained from the coconut-palm.

Courtesy, Abbott Laboratories

Bertram Goodman's painting of savage men terrified by the sight of glowing meteors falling from the sky.

THE EMOTIONS *of the* MIND

PEOPLE used to suppose that knowledge made character, and so they thought that teaching everybody to read and write would make everybody wise and good. Now we know that, though learning things is useful, and though we can not do without knowledge, knowledge in itself does not make us wise and good. Knowledge and the intellect do not decide our deeds one way or the other; they are simply power, and power, like dynamite, may cause an explosion and bury a hundred men, or it may blast the rock which buries them and so set them free.

The boy who learns to write may turn his knowledge to good account by writing something that will make men better for all time, or he may turn his knowledge to bad account by writing poisonous lies.

There is another part of the mind more important than the intellect; more important just because it, more than the intellect, decides our deeds; and this is the part of the mind which feels and wills. The proper name for these feelings is *emotions,* and it is emotions that decide our deeds in a large measure. That is why they are really the most important part of the human mind.

When we come to consider our emotions we find that they must be studied along with what are commonly called instincts. For instance, everyone knows that there is such a thing as the instinct of flight, and we know quite well that flight has something to do with being afraid.

The emotion of fear is one of the great emotions that decide the deeds of men and women and children in all places and ages. We may fear for ourselves or for others; we may fear something in this world or something in the next. But in any case this is one of the great emotions that make history. Fear acts especially by preventing actions; it is the great controlling emotion that keeps people from doing things, and it has always been used by masters and governors of all kinds as an instrument to prevent people from doing what they did not want them to do.

Another important emotion is disgust; and that goes with the instinct which may be called the instinct of revulsion, which makes us shrink from certain things. In order that we may properly control and direct our emotions, we should remember that often

our fear and disgust may result from ignorance, misunderstanding or poor training.

Vastly more important is the instinct of curiosity, which goes with the emotion of wonder. Curiosity has become very marked among the higher animals. The emotion of wonder is very powerful in human life, but it is not really very common in grown-up people in any strong form. Almost all children have it, and perhaps it often leads them into mischief, gets them into accidents, and so on; but boys and girls would learn very little without it.

WONDER AND CURIOSITY HAVE PUSHED FORWARD OUR CIVILIZATION

Among grown-up people the feeling of wonder often dies, and they take all usual things for granted. Yet the instinct of curiosity and the emotion of wonder are immensely important, because in every age they persist in a few people, even when those people grow up. In them it is the main source of their intellectual effort; it is one of the principal roots of science and religion, driving men to discovery and invention and to theories of the world and of mankind. We are on the way toward having a really great man when a strong emotion of wonder and the instinct of curiosity are combined with a fine intellect which these things can use as their instrument. It is a fascinating pastime to try to guess what sort of world we should be living in if mankind had not the driving power of curiosity. For one thing, it is quite likely that neither Columbus nor anyone else would have set out on the dangerous voyages that led to the discovery of America.

Very important also is the fighting instinct, and the emotion of anger which goes with it. This is not nearly so common as the emotion of fear, which in some form or other is possessed by everybody—even by those who think they do not know what fear is.

In the lower animals we generally find that this instinct occurs among females only when they have their young to protect; but at such times they are extremely powerful, as men have known for many ages. Anyone can see the importance of this, for it means the protection of the young and the future of the race; and that is why we find the character of the creature showing a new aspect when she becomes a mother. She is then capable of such tremendous anger that her young are protected from their enemies. We think of the tiger as a courageous and terrible animal, but we are told that in India even the tiger rarely dares to attack a young elephant protected by its mother, though perhaps he would not hesitate to attack the mother herself at any other time.

When we are under the influence of the fighting instinct and the feeling of anger, we sometimes show clear signs of our relation to the lower animals. We are likely to raise the upper lip and sneer and snarl. What this really means, if we knew it, is baring the teeth to prepare for biting. As we grow older these feelings do not disappear in us, but they take a different form, which is not only different but higher. It is one of the great marks of mankind that our instincts may take higher forms as we grow up. In well-developed men anger and the fighting instinct give place to courage, energy and persistence. If difficulties are in the way, they only arouse our resolve to overcome them. So this instinct may have low forms and high forms.

THE INSTINCT THAT CAUSES PARENTS TO CARE FOR THEIR CHILDREN

Next we come to the most important of all our instincts, without which no human being could survive its birth for more than a few hours. This is the instinct of fathers and mothers to care for and protect their young, even at the risk of their own lives. We often call it the mother instinct, though the more correct name for it is the *parental instinct*. So far as we know the world within us and the universe without us, this feeling is the noblest and highest of all instincts, so that we call God Father, and say that God is Love.

THE FISHES THAT DRIVE ENEMIES AWAY FROM THEIR EGGS

This instinct is more important for mankind than it is for any animals, for human babies are born more helpless and need love and care much longer than the offspring of any other living creature. It is not found among the lowest animals, but is found in increasing strength among the higher kinds. So far as we can judge it began in the history of the world with fishes. Some fishes watch over their eggs and drive away enemies which might destroy them. From this stage upward the protection of the young comes more and more to depend on the parents' feelings and behavior, and the young need parental tenderness for a longer and longer period.

At last we reach the highest stage, where

comparatively few young beings are born, but they are so well taken care of that most of them grow up. In such cases, says one authority, "the protection and cherishing of the young is the constant and all-absorbing occupation of the mother, to which she devotes all her energies, and in the course of which she will at any time undergo privation, pain and death. The instinct becomes more powerful than any other, and can override any other, even fear itself; for it works directly in the service of the race, while the other instincts work primarily in the service of the individual life, for which Nature cares little."

No one can question for a moment that this instinct goes with the emotion of love or tenderness. We can see it in cats, and it may often be noticed among birds. During sixteen hours of a summer day a pair of tits carried without interruption two thousand separate morsels of food to their young ones. Only a powerful feeling could enable them to continue such a work.

The feeling of parents for their young is far stronger than the feeling of children for their parents—a proof of the fact that this feeling is not gratitude or expectation of advantage, but genuinely unselfish. From this instinct, and the love which goes with it, spring good things in human nature—generosity, gratitude, pity, unselfishness, true love of our neighbors. When we seem to do good deeds for any other reason than because this feeling is behind us, our deeds are not really good, but are done for the sake of some reward or to avoid some punishment. The great fighting instinct, together with its emotion of anger, is specially aroused whenever the working of some other great instinct is interfered with. We saw how even gentle female nature may become fierce and terrible when the parental instinct joins with the fighting instinct.

SELF-SACRIFICE THE NOBLEST OF ALL OUR INSTINCTS

Perhaps the most completely unselfish instinct is that which prompts one person to sacrifice his comfort or even risk his life to help another person with whom he has no ties of blood or affection, or whom he may never even have seen before. This kind of unselfishness is by no means so rare as we might suppose. In World War II a great many examples were recorded, but many more go unrecorded, both in war and in peace.

When we find a man indignant at some injustice or cruelty—at slavery or cruelty to children—it is tenderness for the helpless, coupled with anger and the strong fighting instinct, that really makes this splendid indignation.

There are some other instincts of less importance; but it will be enough for us to have learned once and for all how important the instincts are, to learn that with each of the great instincts there goes a corresponding emotion, and, above all, to learn that these instincts and feelings have a great deal to do with conduct.

THREE DRIVING FORCES: SYMPATHY, SUGGESTION AND IMITATION

Three words describe other facts of our minds which also explain a great many of the things we do. They are *sympathy, suggestion* and *imitation.* Let us look at them for a minute or two.

Sympathy really means "feeling with," and it is a fact that the signs of other people's feelings do incline us to feel the same way. A baby smiles when it sees a smiling face; a baby or small child is very likely to cry when it hears other children crying. A merry face makes us feel brighter; we are terrified when we hear other people scream with terror. Nothing makes us angry more readily than other people's anger. Everyone knows what a difference it makes to be in one kind of company rather than another.

Suggestion is an extraordinary power we have over each other, whereby we can often persuade each other to do all sorts of things without any real reason. It would be easy to write a book about suggestion, and, indeed, many books have been written on the kind of suggestion that occurs when people have been hypnotized.

WHAT HYPNOTISM CAN AND CAN NOT DO

Most people have heard of hypnotism. Exaggerations about it have found their way into fiction. Some people really believe that a hypnotist, having exerted his influence on a patient, can make that patient do what he wills and believe what he likes, even to the extent of carrying out the wildest commands suggested when in the hypnotic state. Most of that is not true; but some part of it is true for certain people.

The so-called hypnotism of these people is akin to impressing on their minds a suggestion of what is happening or is going to happen to them, and impressing it so strongly that they believe it firmly. One of the sim-

plest examples would be that of a person who was sleeping badly, and having gone to a doctor for a remedy, should be given a dose of medicine to take, with the words: "Now take this just before you go to bed, and you will sleep all right." The dose might contain nothing that would make the patient sleep; but if the patient so thoroughly believed that it did, he probably would sleep after taking it. That would be because the suggestion had sunk into his mind.

In modern medical science, hypnotism is used sometimes as a means of discovering the hidden causes of a patient's mental or emotional ailment. In the middle nineteenth century, Dr. Charcot, of Paris, France, experimented with hynotism as a possible way of curing both mental and physical ills. Soon other medical scientists carried the study of the effects of hypnosis on the human mind still further, and the experiments of Dr. Pierre Janet and others have opened up many paths into the dark places of the human brain.

The important part of hypnotism is that the patient is put into a kind of sleep, during which most of the thoughts that ordinarily crowd the surface of his mind go away, and the thoughts and fears and memories that are usually pushed into the background are more easily reached by questioning and by suggestion. It has been found that both mental and physical ills can sometimes be traced to the troubles hidden in what we call the subconscious mind. Of course, once the cause of the ailment is located, it is far easier for the physicians to find a way to cure it. Not all people can be put into a hypnotic sleep, but it has been found that people who have certain kinds of nervous and mental ailments which can be cured by suggestion are usually more readily responsive to hypnosis.

PSYCHOANALYSIS, WHICH SEEKS TO EXPLORE THE PATIENT'S MENTAL LIFE

A more recently developed method of exploring the minds of human beings is called psychoanalysis. Specially trained psychoanalysts probe with sympathetic questioning to find out all they can about the patient's mental life, gradually bringing to the surface of the mind memories which have long been hidden. This is something like the record that the doctor makes of the past physical illnesses of a new patient.

The human mind is a wonderfully constructed thing, far more wonderful and intricate than any machine that the human mind has itself been able to invent. The Great Power that gave us our minds and bodies has also given us the means to keep them healthy and active. The curiosity to discover how our minds and bodies work; the unselfish desire to help others; and the patience to work hard through disappointment and apparent defeat; these are the gifts that have through the ages enabled our doctors and scientists of all kinds to add to their knowledge of the mind and the body. They have built up a vast reservoir of knowledge and skill, but there are still many more things for us all, doctors and patients, to learn about life and the protection of life. Many boys and girls who are now in school will grow up to take their part in the great work of increasing that knowledge and that skill.

IMITATION, BY WHICH CHILDREN AND GROWN-UPS LEARN

There is one more instinct of importance which we spoke of together with sympathy and suggestion. This is imitation. We all know how little children learn to do things by watching and imitating the actions of older children or of grown-up people. Sometimes this imitation brings about accidents, but on the whole the results are good, for imitation is a part of the educational apparatus of the human race.

Little children are not the only people who learn by imitation. Grown-up people of all ages imitate others to a greater or less extent. Sometimes they imitate others as a help to learning useful knowledge. A great deal of imitation, however, seems to come simply from the human desire to be like other people of one's group or community. It is this kind of imitation that makes style and fashion in dress, or builds up habits and customs of living. As with all other human instincts, the results are often extremely worth while, but sometimes tragic or silly.

One of the greatest lessons that all of us must learn as early in life as we can is to think carefully before we imitate the speech or actions of others. We must always ask ourselves whether a course of action is good before we adopt it. Even if someone whom we love and admire does a thing, it does not follow that it would be the right thing for us to do. In that way we shall be able to guide our instincts and our emotions so that they will give their best service to ourselves and to others.

THE NEXT STORY OF OUR OWN LIFE IS ON PAGE 4553.

A shelter under the rocks.

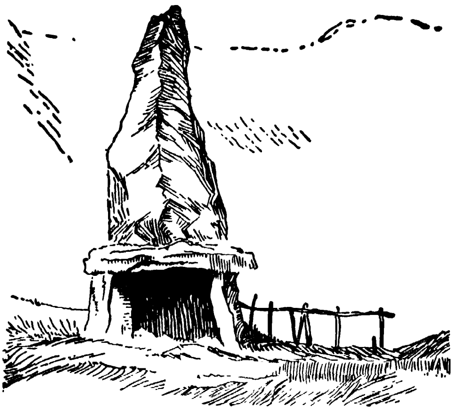
HOW EARLY PEOPLES WERE HOUSED

LONG, long ago, there was a time when the people did not have homes, but wandered from one place to another. About the only shelter which these primitive people had was the wide-spreading tree, under which they protected themselves from the hot rays of the sun and from the rain during the day. Perhaps they slept in the branches at night for protection from wild animals. These people had doubtless been in caves from time to time, but probably they found it necessary to choose tall trees in order that they might be safe from the wild animals. The location of the tree-dweller's house was usually near the river, where he might have fresh water at a convenient distance. On the other hand, it was desirable for him to be located where roots and berries, his chief foods, were found in abundance. Later these early people learned how to use fire, and with its protection began to build crude brush huts on the ground. During the summers these huts answered the purpose very well, but when the cold weather came they were confronted with a new problem. They then left their huts and caves in the rocks and holes in the earth became their warmer shelter. The new discovery of fire had not only given them a means of keeping the wild animals away but it had also furnished their homes with ample heat.

Somewhat later they learned how to make shelter from branches which were covered either with leaves or with grass. This soon led to the making of huts by twisting the branches together and chinking them with mud. To-day in some parts of Australia and in the southern tip of South America the forms of shelter are still of this most primitive type. The little homes of the Pigmies of Central Africa are no better. Their homes are made of branches stuck into the ground in such a manner that they lean toward one another. After the tops of the branches have been tied, the sides are thatched with leaves and grass. The Negritos, known as the Black Dwarfs of the Philippine Islands, live in similar homes. In the southwestern part of our own country there are still some remains of the Indian cliff-dwellers, who lived in crevices of the cliffs, which they walled up with stone. Other clans of cliff-dwellers have been located farther south, in Mexico.

The first real home that replaced the cave homes and the brush tents was probably built of stone. The early stone home consisted of rude walls of piled stones and was usually covered with a roof of finer stones and some mud. This form of shelter was later improved, however, by cutting the stones into blocks.

The Arabs used tents for their shelter, as it was necessary for them to move from place to place to get food for their flocks and herds. For people who needed a permanent home, the hut was without doubt the simplest form. This is the chief dwelling of the Africans and the South Sea Islanders,

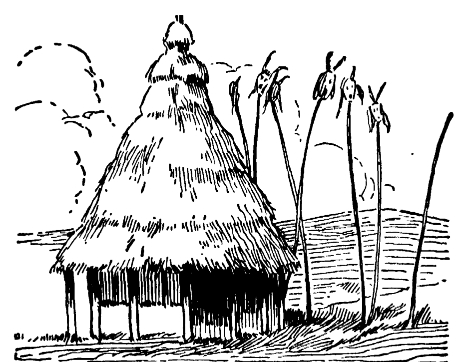

Another form of stone shelter.

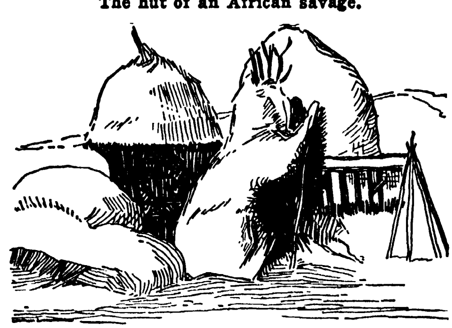

Two forms of early branch and grass huts.

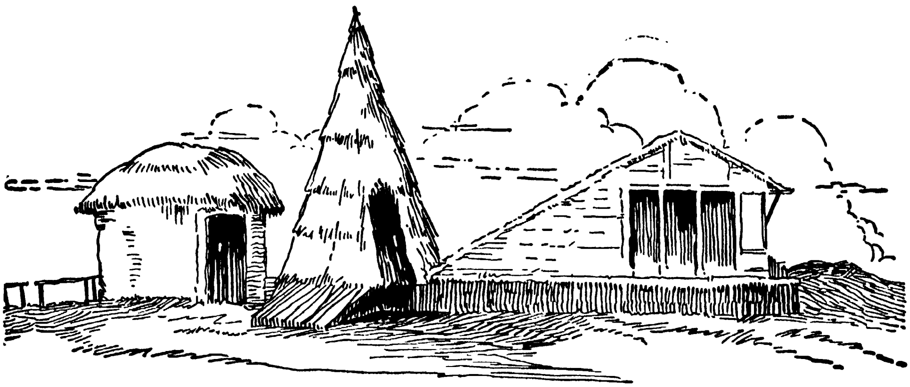
and also furnishes homes for many of the people in China, India, South America, southwestern United States, Mexico and some parts of Europe. The climate and the materials of the particular locality largely determine the nature of the huts. Some of the Eskimos, who live in skin tents during the summer, use snow and ice to make their winter homes. These huts, called igloos, are usually built half underground and are roofed with snow and ice. Through ground and walls passages are dug so that the people can crawl in and out. Some Eskimos use driftwood in making their huts.

Even to-day in some backward countries the poorer natives live in bamboo huts, which are covered with grasses, earth, and the like. These huts are used mainly in tropical climates, as they help keep the people cool. In some parts of the desert of Sahara miners make their huts of blocks of salt. As there is no rain in that district, the salt is used for the roofs as well as the walls. In other mining districts materials such as iron are used in the building of huts. The Egyptians in the Nile valley live in huts of sun-dried bricks. In most of these huts the cooking is done outside, as the interior is low and small. Many of the inhabitants of the tropical countries live in homes which cannot be classed as huts. These are built of grass, cane and leaves. Besides being roomy, they often compare very well with our homes, so far as light and neatness are concerned. Some of these have an artistic quality due to the simple arrangement of the woven patterns which are frequently dyed in harmonious colors.

In the western part of China some of the people still live in caves. However, millions of the poorer people live in houses of mud, made of sun-dried bricks or of clay plastered over a framework of bamboo. Occasionally thatch is used for the roof, but clays or tiles are used more often. The better homes, however, are made of gray brick and are roofed with black or gray tiles. The typical roof is of a heavy ridge shape, having its sides curved prettily in a graceful, sweeping line. Such roofs extend a short distance out beyond the walls of the house. The buildings of the Japanese people are often as delicately constructed as our best furniture. Their houses are built largely of wood and are roofed


The hut of an African savage.


The hut of a Laplander.

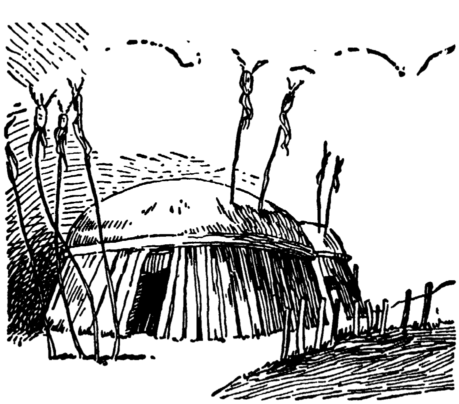


Three typical huts built by the natives of India.

with either black tiles or thatch. Their roofs are usually made in sections which are placed in their proper places. The walls are so fitted into grooves that they slide back and forth, making several rooms into one. Some of these houses have their outer walls made in sections so that the whole house may be opened during the day.

Some American Indians lived in *tipi* (tee-pees) before the white men came, and in fact, a few Indians still do live in *tipi*. These tents were made by sticking several poles in the ground so as to form cone shapes, which were covered with mats, grass and barks. Some tribes used deerskin, others used buffalo skins, sewed and laced together. There were several other kinds of Indian homes. These are described in the chapter beginning on page 241. In many parts of the American colonies the people at first lived in simple shelters like those used by the Indians. But it was not long before they began to chop down trees, hew the logs into lumber, and erect them into cabins. Neighbors helped each other in putting the structure together and in raising the framework for the roof. Most of the cabins were built of logs notched near the ends and laid horizontally, each one upon another. These were crossed at right angles and formed an oblong or square room, logs being added, layer by layer, until the house was of the desired height. Then the framework for the roof was raised into place. This was covered with thatch, clapboards or split shingles. The house was then made tight by filling all the cracks between the logs with sticks, moss and grass, after which these were plastered over with clay. The floor was made by pounding down the earth; or, in the better cabins, it was made by splitting and hewing logs. A large fireplace was built at one end of the cabin, with a great mud-and-stone chimney, and much of the life centred around the fireplace.

THE NEXT STORY OF ALL COUNTRIES IS ON PAGE 4565.



A Mexican hut.

A Gallic hut.

Courtesy, Virginia State Chamber

WHERE DOES AN APPLE COME FROM?

WE know that when we sow seeds properly they grow, and from a very small seed we may get a very big tree. It may be an apple tree, and it may produce hundreds of apples year after year. Where do they all come from?

Or, to take another instance, we plant one pound of potatoes and harvest a hundred pounds of potatoes. Where does all the difference come from? It almost looks as if the ninety-nine pounds of potatoes were new weight in the world, but the world gets scarcely any heavier, so that can not be the answer.

The apples and the potatoes have been made by the wonderful power of the living tree or plant out of the soil, the air and the moisture in which they live. In the case of the potatoes, we are quite sure that if we could have weighed the matter taken in as food by the first pound of potatoes it would have weighed ninety-nine pounds. The earth as a whole is not any heavier; what happens in the case of the apple tree is that some of the things that make up the weight of the air, such as oxygen and the carbon from the carbon dioxid on which the plant feeds, and some of the things that make up the weight of the ground, such as water and salts, have been built into its body.

It is as if you had a house that could build itself, and make its own bricks into the bargain. And so it is in the case of the apples or the potatoes—or you. Part of the earth has been built into apples and potatoes, and the builder in this case is the living plant. After a time—and this is true of every living creature—it dies, and the stuff which was taken from the earth and the air for making its body is restored to them, and other living creatures use it in the same way. So there is a circle or cycle—the cycle of life—through which much of the stuff of the earth and the air passes.

It might be thought, then, that, as the air gives so much to the apple, the air would be lighter in summer, when the apple grows, than in winter; but we should not like to say that the air is lighter in summer than in winter on this account. In the first place, the weight of the air is so great that all the oxygen taken from it for the purposes of life is like a drop of water as compared to the ocean; and in the second place, there are many other things happening which might work in the other direction.

For instance, under the influence of the sun many of the products of past life lying on the surface of the soil are broken up, and the oxygen they contain is given back to the air. Animal matter breaks up more rapidly under the influence of heat.

HOW DID THE STONE GET INSIDE THE CHERRY?

The stone, or, rather, the living seed inside the stone, is the important part of the cherry. This is the part that will grow into a new cheery tree if given a fair chance. The juicy part, which we prize, only helps to give the seed a fair chance.

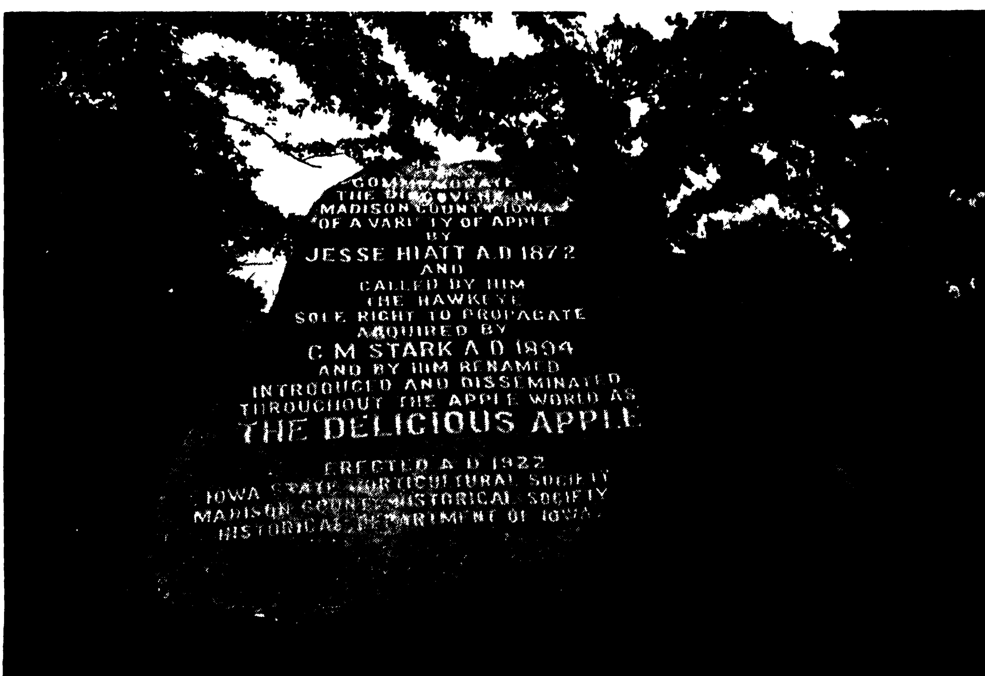
Birds prize the juicy part as much as we do. A bird picks a cherry from a tree and carries it away; it eats the soft part and drops the stone to the ground. The time comes when the seed starts swelling. Presently the hard covering splits, and the sprout shoots up, and a tiny root pushes into the earth. A new fruit tree has started to grow. Much the same story can be told of plums and peaches and other fruits that have stones.

HOW DOES THE MILK GET INTO THE COCONUT?

The stuff that we call the milk of the coconuts does not get into the coconut from outside. It is made in the nut by the tissue or substance of the nut itself. Of course this liquid is not milk. It would be a puzzle, indeed, if real milk were found in coconuts, for milk is formed only by the milk glands of certain animals called mammals. Various plants besides the coconut produce fluids that look milky, and are often called milk; but no plant produces anything like real milk. The milk of the coconut is very pleasant and refreshing to the taste; and the natives of many tropical isles depend on it for drinking, and on the nut meat for food.

WHERE IS THERE A MONUMENT TO AN APPLE?

In Madison County, Iowa, there stands a monument to the parent tree of the variety known as the Delicious apple. About a century ago a young Quaker farmer named Jesse Hiatt planted an orchard in Iowa and started to grow apples. In the spring of 1852 a shoot issued from the root of a dead apple-tree trunk, and when it grew to a tree it produced apples of quite a new variety —big red apples with a special flavor and aroma. Hiatt named the apple Hawkeye, and for years the tree bore its crop without attracting much notice. But when he sent the apples to a big show in 1893, the judge, biting into one, exclaimed "Delicious! De-



Iowa State College

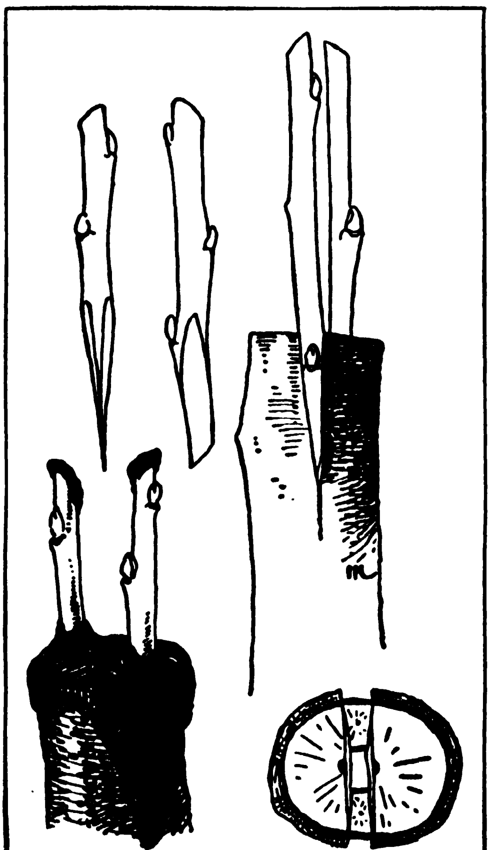
In Winterset, county seat of Madison County, Iowa, stands this granite monument to the Delicious apple.

licious!" And the variety has become famous the world over. By 1922, the tree had been bearing fruit for half a century in the farm orchard near Peru, Madison County, Iowa. In that year a granite monument in its honor was set up in the beautiful city park at the Madison County seat, Winterset.

The offspring of the first Delicious apple tree now numbers seven or eight million trees. The annual market value of Delicious apples must be at least twenty million dollars.

WHAT DO FARMERS MEAN BY GRAFTING?

Grafting is the process by which two or more varieties of fruit can be made to grow on one tree. The size of the stock usually determines the method to be followed. A common form is that of cleft grafting. For this a small branch—little more than a twig —about half as thick as the little finger, is cut from the bush or tree that we desire to graft on another tree. This must be done in the early spring, and the grafts should be placed in a cellar or other cool place for a few days. The little branches are cut into lengths of about nine inches, and each graft should contain three buds of the last year's growth. The end to be inserted in the wood is cut in the shape of a wedge, so that it may be pushed in easily.



Bureau of Plant Industry, USDA

Steps in making a cleft graft—the cross section shows how the cambiums of stock and grafts come together.

When the time for grafting comes, the branch upon which the graft is to be made is cut back, a slit is made and held open by a small wedge. Then a graft is placed at each end of the slit, and pushed in tight. The wedge is removed; grafting wax is spread thickly over the wound; and for added protection during the time of healing a white cloth is wound over and around the branch.

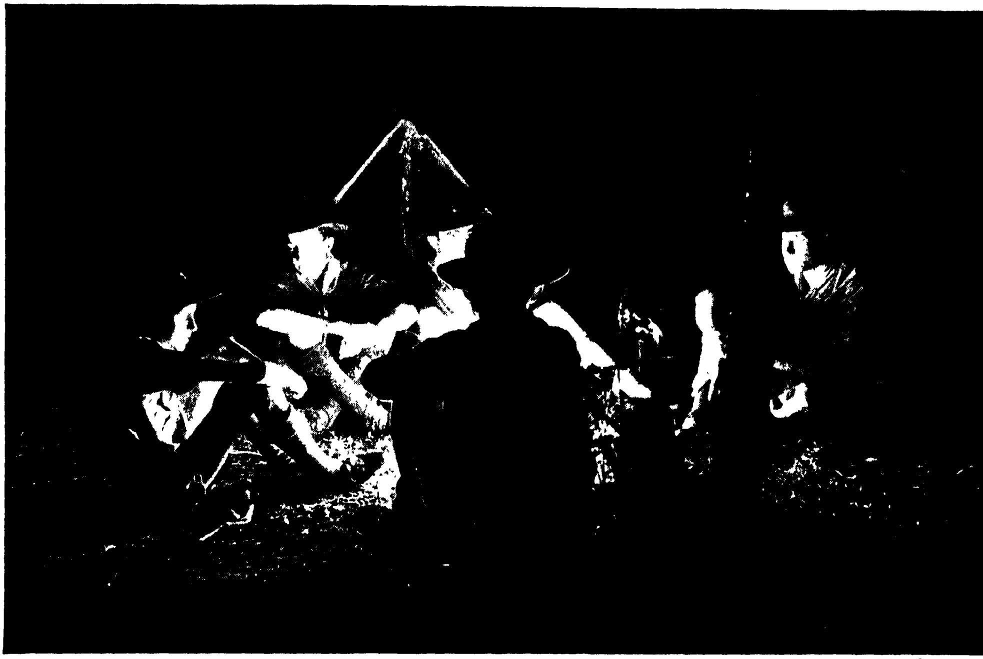
Two grafts are used because the wound in the branch heals more quickly if both ends are closed, and the chance of obtaining a successful growth is doubled. Luther Burbank made his grafts on very small branches. In placing the grafts care must be taken to see that the cambiums of both stock and grafts come together, otherwise the graft will not grow. The cambium is the layer of growing tissue that lies just inside the bark of a tree trunk or branch. The graft is technically known as the cion, or scion.

WHAT IS THE DIFFERENCE BETWEEN A FRUIT AND A VEGETABLE?

Every fruit is a member of the plant world, that is, of the vegetable kingdom. However, we make a difference between certain plant parts when we use them for food. What we commonly call fruits are, in general, those sweet fruits that we eat for dessert: apples, oranges, bananas, grapefruits and so on. We give the name vegetables to those plant parts—whether roots or stems or leaves or fruits—that we usually eat with the main part of lunch or dinner. We eat, as vegetables in this sense, the stems of celery, the leaves of spinach, the roots of carrots, the fruits of tomatoes, peas, beans, cucumbers and many other plants. In other words, when we eat the seeds and seed-cases of plants we are, properly speaking, eating fruits, though some of them may be listed as vegetables at the grocer's.

Even some things that both the botanist and the grocer call fruits may be eaten as vegetables, such as broiled bananas, for instance.

THE NEXT WONDER QUESTIONS ARE ON PAGE 4490.



Paul Parker photo

One of the most exciting parts of Scouting is "overnight camping"—to sit around the campfire, under a clear night sky, singing songs and telling stories; then perhaps sleeping under the stars.

THE BOY SCOUTS OF AMERICA

MOST American boys know something about the Boy Scouts of America. Any boy in the nation can join. There are three age groups: Cub Scouts, nine to eleven years old; Boy Scouts, twelve years and older; and Senior Scouts, fifteen years and older.

When a boy reaches his ninth birthday, he may join the Cub Scouts and start a new game which his whole family plays with him. He joins a Cub Pack and a Cub Den. His Cub Den meets weekly in his home or the home of another Cub Scout. He has a leader, the Den Chief, who is an older boy, and he has a Den Mother. Maybe his father is a Den Dad. Once a month there is a Pack meeting of all the Dens in his Cub Pack.

Cub Scouts have a uniform, dark blue with gold. The Cub Scout Motto is "Do your best." The Cub Scout Salute is given with two fingers touching the Cub cap visor. Here is the Cub Scout Promise: "I promise to do my best to be square and to obey the Law of the Cub Pack." Cub Scouts have their own sign and handclasp and have a secret way of writing that only Cub Scouts can understand.

When a boy comes into Cub Scouting he becomes a Bobcat. As he learns how to do certain things, he advances in rank. At nine, he is a Wolf Cub; at ten, a Bear Cub; and at eleven, a Lion Cub.

Here are some of the things that Cub Scouts learn to do that are a lot of fun and teach the Cubs how to be strong as well as happy: feats of skill and safety, such as jumping, swimming, running or somersaults; making things, such as whittling, carving, leather work, pottery or weaving; collections, such as stamps, stones, leaves, coins, tags; making scrapbooks; how to tie packages, shoe strings and ropes; a secret-writing code; Indian craft; and forms of respect to the flag.

When the Lion Cub Scout is twelve years old, he may become a Boy Scout.

A Boy Scout hikes through the woods and camps in the open. He can kindle a fire on

LEARNING IS FUN FOR CUB SCOUTS

Making beaded belts or necklaces requires skillful fingers.

Paul Parker photo

A future airplane pilot makes a model plane—thinking, perhaps, of the day when he will fly his own, real craft.

Cub Scouts learn to "dish up" their own food, while on hikes; and they can do it with very little equipment.

Learning to tie various knots is valuable training that every Scout must have. Knot-tying is only one of the useful skills that a Scout may employ long after he has left Scouting and is a grown man.

the wettest day; and, like an old pioneer, he reads the signs of the trail. He can tie a knot that will hold; he can swim a river and pitch a tent; he can mend a tear in his uniform, and cook his own dinner. He knows which fruits and seeds are poisonous; he can sight nut-bearing trees from afar. He can reef a sail or pull an oar. He knows the stars by name and can find his way by their guidance. The birds and animals and fish are his friends.

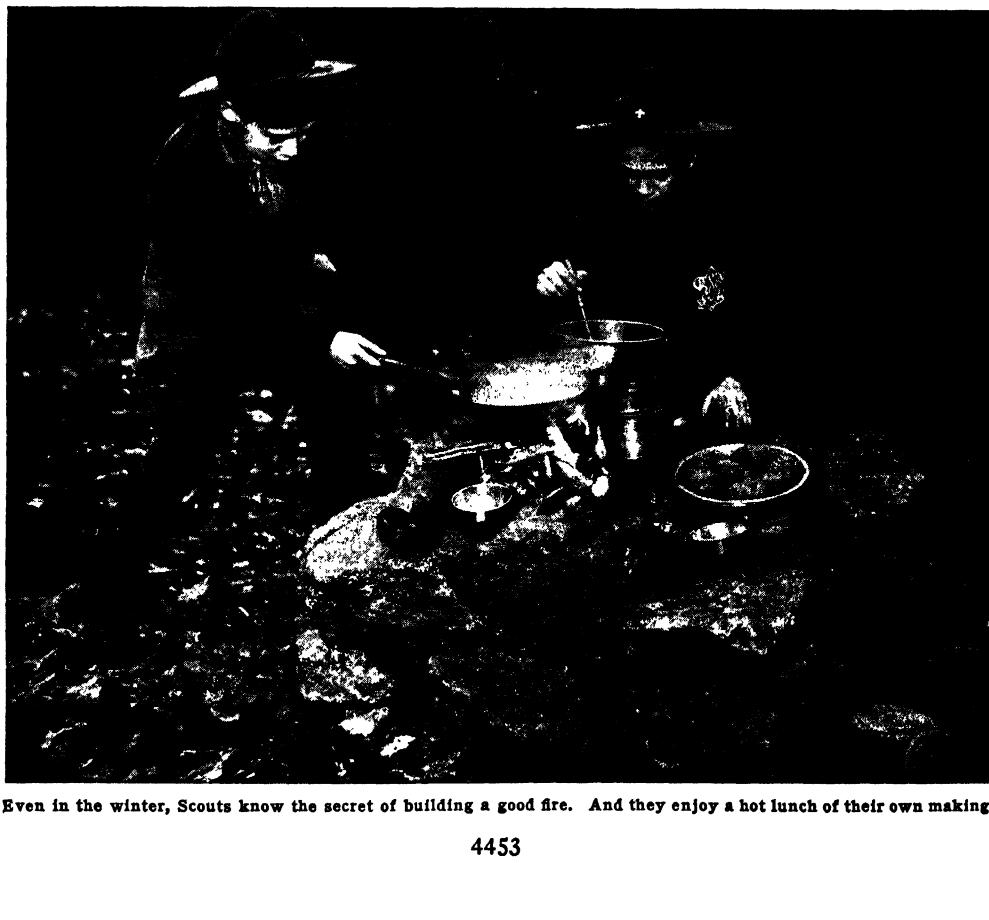
A Scout never flinches in time of danger. He knows what to do in case of fire, panic or accident. He trains his body, and in all emergencies he sets an example of courage, coolness and resourcefulness. He is especially thoughtful for the helpless and weak. His love of adventure and heroism, his energy and initiative have the right outlet. A Scout makes himself known to a brother Scout by a sign that only Scouts may give. He has brothers in every city in the land and in every country in the world. Wherever he goes his brother Scouts give him a friendly welcome and make him feel at home.

A Scout knows his city as well as he knows the forest trails. He can guide a stranger through the streets; and he knows where fire alarms and police stations are located, and where the nearest doctor lives. He is familiar with the names of the city officials and their duties. He is proud of his city and glad to serve whenever he can.

The Boy Scout is first a Tenderfoot Scout. He learns certain things and becomes a Second Class Scout and, after he learns more skills, he is a First Class Scout. After that, if he works faithfully, he can advance to Star Rank, Life Rank; and finally he can be an Eagle Scout, the highest rank of all.

The Boy Scout Motto is "Be prepared." Boy Scouts have a sign and a salute of their own. Every Boy Scout makes the following Promise:

"On my honor I will do my best: To do my duty to God and my country and to obey the Scout law; to help other people at all times; to keep myself physically strong,



Even in the winter, Scouts know the secret of building a good fire. And they enjoy a hot lunch of their own making.

mentally awake and morally straight." The twelve points of the Scout Law are as follows:

1. A Scout is trustworthy.
2. A Scout is loyal.
3. A Scout is helpful.
4. A Scout is friendly.
5. A Scout is courteous.
6. A Scout is kind.
7. A Scout is obedient.
8. A Scout is cheerful.
9. A Scout is thrifty.
10. A Scout is brave.
11. A Scout is clean.
12. A Scout is reverent.

Here are some of the things that a Boy Scout learns: how to tie useful knots; first aid; signaling; Scout's pace, by which a Scout can cover a mile in twelve minutes; how to use a knife, a hatchet and an axe; how to build a fire in the open and put it out, and cook over it without any utensils; how to use a compass, to draw a map and follow it; how to judge distance, size, number, height and weight; how to identify trees, flowers, birds and wild animals, and the stars at night.

Most people know the Scout uniform, khaki with bright neckerchief, that only Scouts may wear.

When a Scout has reached First Class Rank, he may earn Merit Badges for specializing in particular skills, such as camping, bird study, lifesaving, swimming, fingerprinting, photography and many other skills.

Boy Scouts belong to Scout Troops. A grown man leads a Troop; he is called a Scoutmaster. Troops are made up of Patrols of about eight boys each. There is a boy leader for each Patrol known as a Patrol leader.

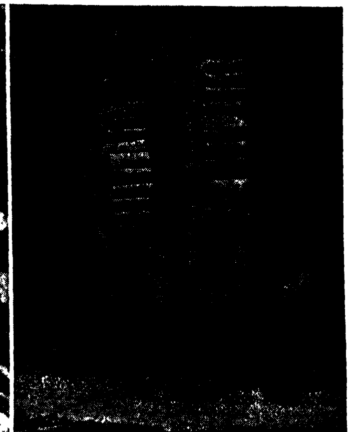
When a boy is fifteen, he may come into Scouting as a Senior Scout and follow one of three programs according to his interests. He may be an Air Scout, specializing in aviation; an Explorer Scout, who is an advanced camper and explores the wilderness; a Sea Scout and learn about the skills of seamanship and how to manage a ship in all kinds of weather.

Scout Units are organized by agencies in a boy's home town, such as a church, a school, a Grange, or perhaps a group of fathers and mothers, or a club. Cub Scouts join the nearest Cub Pack to where they live. Boy Scouts are members of a Boy Scout Troop. There are Senior Units for the Senior Program. A boy who wants to join one of these programs should ask at the Unit nearest his home; or he may write to his Scout Council if he knows the address. The address of the home office of the Boy Scouts of America is 2 Park Avenue, New York 16, New York. If he writes there, he will get help in becoming a Scout.

Some boys live on farms or in villages where there are not enough boys to form a Cub Pack or a Troop. Such boys can be Lone Scouts or Lone Cubs. If there are two boys who want to come into Scouting, they can organize a Neighborhood Cub Den or a Neighborhood Scout Patrol with a man

A Scout's first-aid training and presence of mind may help to save a life.

SCOUTS IN WARTIME "PITCH IN"



Scouts collected books for servicemen.

Learning about farm machinery is important to boys in agricultural areas of the country.

Collecting old paper was one of the many good jobs the Scouts did during the war.

Farmers were grateful to the Scouts for their help in harvesting crops while so many older men were away.

Scenes like this were numerous all over the country during the Scouts' metal-salvage drive.

as leader who will help them to learn the things that boys in Packs and Troops learn.

Here is a story of how his training helped one Scout. He was so freckled that the boys called him Turkey Egg. He had a buddy named Bob. One summer during vacation Bob had a job at the bottle-capping machine in a soft-drink factory. One day something went wrong and there was an explosion—the crash of a burst bottle. A sliver of razor-sharp glass flew out and cut Bob's wrist. Bright blood spurted out; an artery had been severed!

Everybody ran around in circles. Somebody thought to telephone the doctor of the little town, but he was out. Severe arterial bleeding can cause death in only a few minutes. Nobody knew what to do.

Then, in rushed Turkey Egg! Turkey Egg knew his First Aid. He sized up the situation; caught up a handkerchief and with that and a lead pencil, applied a tourniquet. He had one of the men hold it; he took a roll of clean gauze bandage from the company's First Aid kit, put a compress over the wound, held the arm up with the help of a sling, and tightened and loosened the tourniquet as needed. At last the doctor arrived and took charge. Said he, "A mighty good job. The boy is alive only because this Scout knew his First Aid."

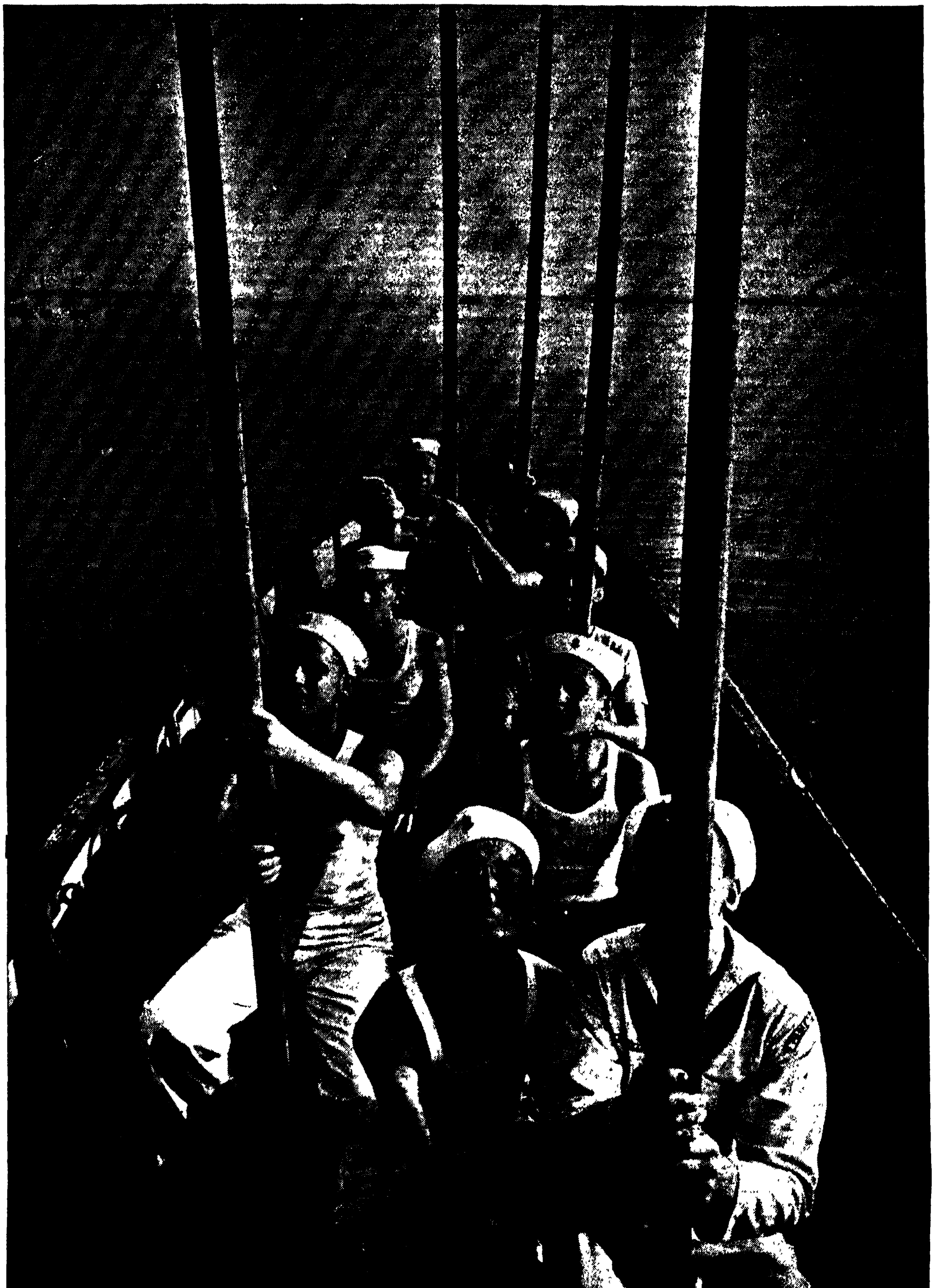
One summer day on a farm in Idaho a boy was raking hay. A heavy team was pulling, when the bolt which held the neck yoke to the tongue broke, letting the tongue drop. The frightened horses started to run. The boy had no chance to jump. The team broke free from the rake and the broken tongue struck the boy's right leg, running in about three inches and cutting the large artery. Disaster and death for most boys! Other workers ran up, but were powerless to help because they did not know what to do. A doctor was miles away, and although some one started at once to fetch him, it looked as if the boy would bleed to death before help arrived.

Yes, but this boy was a Scout! With the

After their long hike through the country, the Scouts will choose a camp-site.

At the camping grounds the boys set up their Indian-style tent and prepare to spend the night in the outdoors.

SEA SCOUTS OFF FOR CREW PRACTICE



Boys who have hopes of being seamen some day join the Sea Scouts when they become Senior Scouts. Sea Scouts learn all the basic crafts of seamanship, and enjoy the thrills and excitement of the water.

Air Scouts see how planes are made, transported and flown—a real thrill for the young man who is air-minded!

help of the other farm workers he used his First Aid knowledge on himself. He instructed one man how to hold his thumb on the pressure point, because the puncture was so high it was impossible to use a tourniquet. The Scout knew where the pressure points are and how to apply the pressure. By the time the doctor arrived, the bleeding was practically checked. This Scout owes his own life to his Scout training.

How about Boy Scouts when they grow up? Well, they are leaders everywhere. Some of the greatest heroes in the war were former Scouts. Boys will find that many of the leading citizens in their home communities either were Boy Scouts or are connected with Scouting in some way. The President of the United States of America is the Honorary President of the Boy Scouts of America. Every boy should listen particularly to his radio during Boy Scout Week, in February. Then outstanding men all over the country broadcast messages on Scouting and the valuable training that it gives to the boys of America.

The Boy Scout idea was started by an Englishman, Lord Baden-Powell, in England. It was brought to this country in 1910, and February 8, 1910, is the Scout birthday. Congress granted a federal charter to the Boy Scouts of America in 1916 because the Boy Scouts did so much for their communities and their nation.

There are Scout organizations in more than seventy different lands. During the second World War, the Axis dictators tried to stamp out Scouting in the countries they invaded. They forbade Scouts to hold meetings and sometimes even shot them; but Scouting went underground and, when the war was over, there were more Scouts throughout the world than ever.

Scouting helps to build good will over the world because Boy Scouts, no matter what language they speak or in what country they live, are dedicated to the same ideals of trustworthiness and honor and world friendship.

By LORNE BARCLAY.

THE NEXT STORY OF THE UNITED STATES IS ON PAGE 4517.


Atalanta running.


A gladiator.


Paris with the apple.

THE OLD EMPIRES AND NEW EUROPE

A GREAT change came over Greek life and art when Alexander the Great began to be a power in the year 336 before Christ. When we think of the sculpture of the earlier centuries the images that rise in the mind's eye are lofty images—pure and simple statuary of gods and heroes, designed and wrought on a grand scale.

Under Alexander Greece became one of the provinces of a man whose ambition was to be master of the world; and, instead of reflecting an ideal of thought, her art began to reflect the glory of a court and the pomp due to an emperor. Alexander carried Greek culture with him wherever he went, and the change thus brought about, when Greek art was implanted in Asia Minor and traveled as far as India, was of tremendous importance in the history of the world. From this time on Greek art is called Hellenistic.

In the sphere of art and letters Athens gave place to other cities—Alexandria, Pergamum, Ephesus, Rhodes—and in them for many generations the best Greek art of the period was produced. Schools of sculpture arose, a great deal of the work being done to glorify Alexandria, the new city founded by the conqueror and the other towns brought to prominence in his reign. At Ephesus was built at this time the famous Temple of Diana, one of the seven wonders of the world. The story runs that Alexander the Great offered to pay the cost of this structure if an inscription in his honor were placed on the building, but the Ephesians declined his offer. Some noble fragments of this temple are to be seen at the British Museum. Alexandrian sculpture was mainly decorative, and never so strong as that of Pergamum.

During his short reign Alexander himself was the moving force behind all art activities, and his influence was felt long after he was dead. A great many portrait busts of the emperor were made and set up in various cities, and his head was struck on the coins. This marks a very significant change, because until his day the coinage had been stamped solely with heads of the gods. Lysippus made the most famous statues of Alexander. As the emperor led, his subjects followed. Portrait sculpture became the fashion, and some good and some merely flattering work was done.

Of the decorative sculpture put in the numerous temples and public buildings set up in Asia Minor very few traces remain. Fragments here and there have been discovered. The most famous is the magnificent Sarcophagus of the Weepers, discovered at Sidon

about 1887, now in the museum at Constantinople. It is built of Attic marble, and is one of the greatest pieces of decorative art which later Greece produced.

The change in the whole outlook of Greek art from about the time of Alexander is shown in several ways. The ancient Greek had divided the world into two classes, Greek and barbarian, and he had looked on all men who had the misfortune not to be Greek with a certain contempt, and ignored them in his art. Now, however, the barbarian, the Ethiopian and the Gaul began to figure in the sculpture of Greece.

Another very interesting change came in the introduction of landscape and ordinary domestic life into reliefs and decoration. Greek sculpture of the great age had been wholly absorbed in heroic figures—the doings of the gods and legendary people. Now, probably because artists were brought into contact with Egyptian art, which had such a pleasant touch for the everyday things, their sculpture became more human. They showed interesting little scenes in their reliefs—peasants in their huts, reapers at work, poets writing, herdsmen with their cattle. Sometimes, strangest of all in this new development, the relief was purely pictorial, showing rocks and trees and streams, evidently carved with intense interest by an artist who knew he was doing something new.

THE TIME WHEN GREEK ART WAS BLENDING WITH THE ART OF ROME

But from the point of view of pure sculpture, the greatest change in the Alexandrian era came in the creating of statues that showed extreme suffering of mind and body. In order to make their thought plain, sculptors exaggerated the horror of pain, twisted bodies about in dreadful contortions, carved faces in expressions of terrible anguish.

The most famous group of this kind comes from the island of Rhodes and belongs to the latest period in the first century B.C., when Greek art was merging into that of Rome. It is called the Laocoön, and is the work of three sculptors—Agesander, Polydorus and Athenodorus. The Laocoön shows a scene in the mythical Trojan War. A Trojan priest called Laocoön had defied the gods, and as he stood on the seashore with his sons there came out of the sea two huge serpents who threw themselves on the youths. The father seized the serpents to save his sons, but all three were crushed and bitten to death. The group is in the Vatican at Rome, but it has become familiar through innumerable copies in plaster.

The Laocoön is a magnificent rendering of a dramatic moment in a terrible death, but it is bad art. Let us never forget that. The subject is not within the province of sculpture, and to the Greeks of the great years would have been impossible: their taste was perfect.

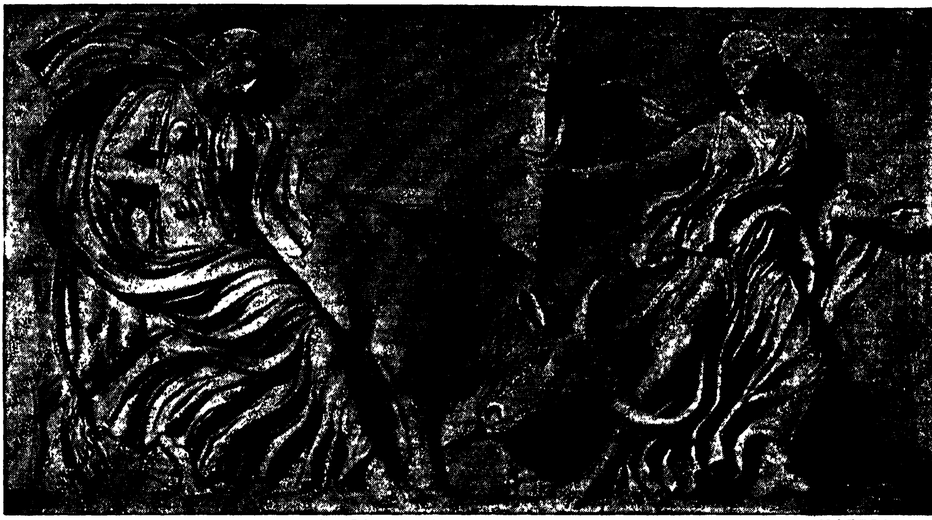
THE SCENES OF TERROR THAT ARE OUT OF PLACE IN ART

We should always remember, as a guide in taste, that anything in art which preys easily on the emotions, that makes one "creep" and be afraid of dreaming, is bad. It is particularly bad in sculpture because there is something eternal in a solid-marble representation of the human being, and therefore it should be concerned with enduring things. Death itself is beautiful and not dreadful. And intense suffering most mercifully never lasts long; it is a fugitive, if terrible, emotion, and should not be portrayed in art. It may be expressed in verse or a story, for then it is only a matter of a page or a chapter, and the author can take the reader on past it and allow him to see it as part of the whole. For this same reason a critic has said that Leonardo da Vinci's Mona Lisa is false art because it immortalizes something as fugitive as a smile.

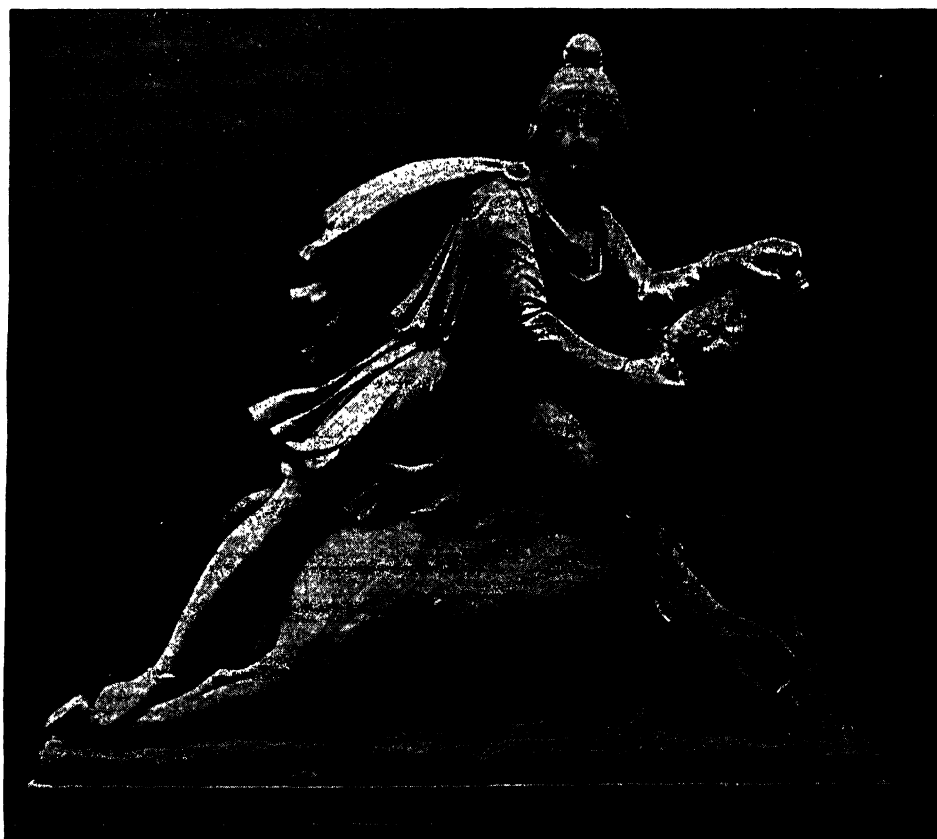
The famous Farnese Bull, a great marble group made by sculptors of Rhodes and now in the Naples Museum, is another instance of the last and decadent stage of Greek art. It is not so terrible as the Laocoön because it does not show actual suffering.

A much more dignified example of suffering is the scene—Athene slaying a young giant—in the frieze of the huge altar to Zeus at Pergamum. And a better example still is the bronze statue by a sculptor named Epigonus that used to be called the Dying Gladiator, and is now known to be the Dying Gaul. A marble copy of this is in the Capitol, Rome.

To the city of Pergamum about 240 B.C. the fortunes of war brought a strong group of artists. King Attalus, who had just driven off the Gauls, ordered them to make a number of statue groups in honor of his victory. These men settled in Pergamum, and in that city grew up

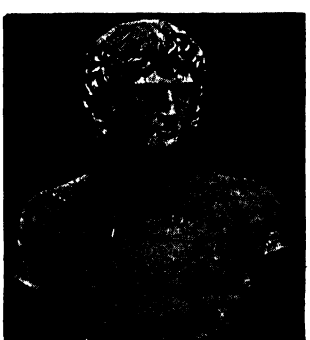


WOMEN LEADING A BULL TO SACRIFICE—AN ANCIENT SCULPTURE IN THE VATICAN



MITHRAS SACRIFICING A BULL—A ROMAN SCULPTURE OF THE SECOND CENTURY A. D.

The Death of Laocoön and His Sons, a group from the island of Rhodes, by Agesander, Polydorus and Athenodorus.

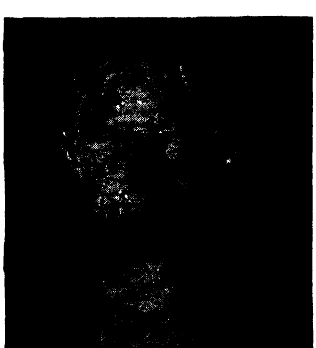


Antinous, the friend of Hadrian.

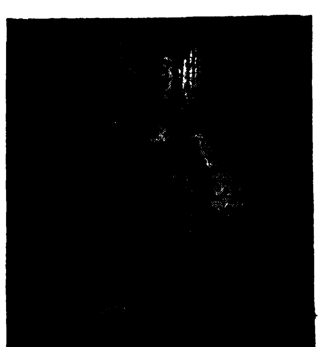
A fine head, perhaps of a German captive.

The Clytie—a Roman portrait of the Augustan Age.

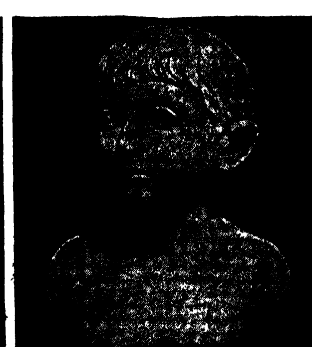
The famous group known as the Farnese Bull, made by Rhodian sculptors and now in the Naples Museum.



Augustus as a Boy.

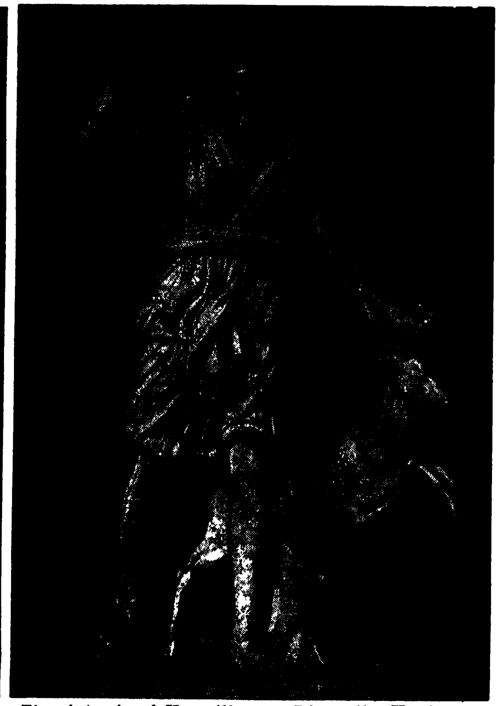


The Boy and the Goose, by Boethus.

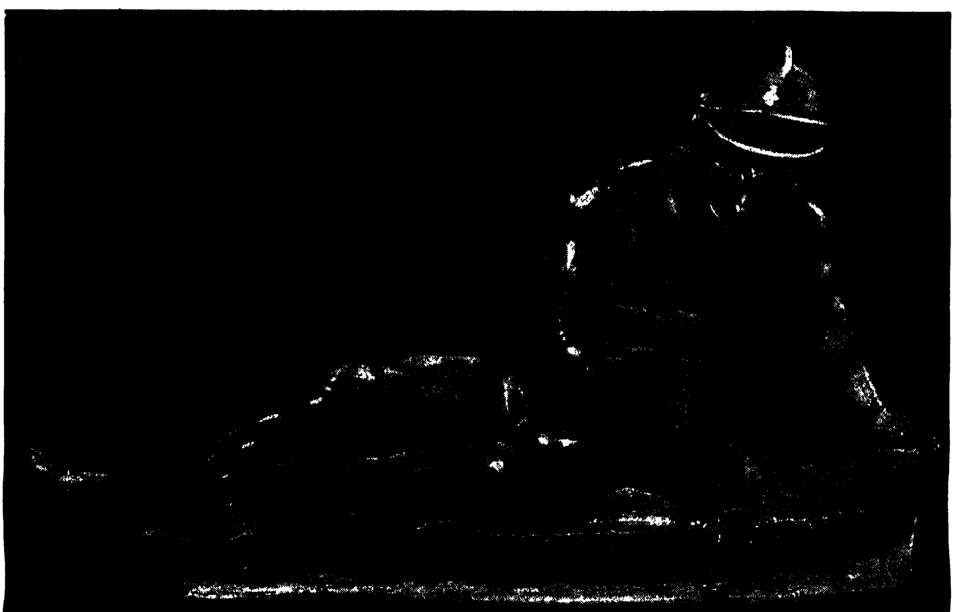


A Young Boy's Head.

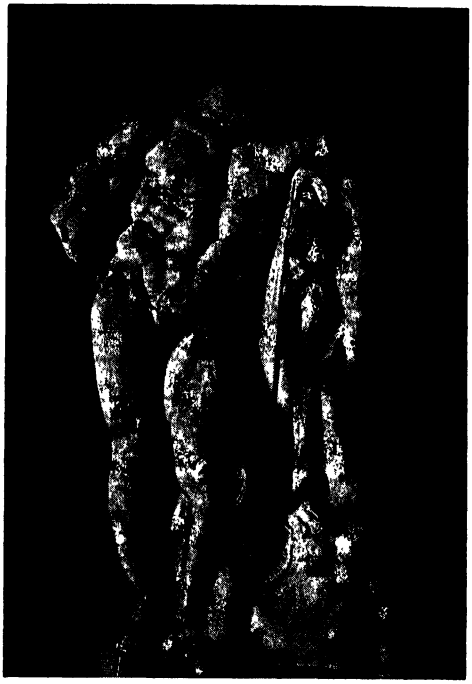
The Apollo, in the Belvedere of the Vatican. Copy of a bronze statue.

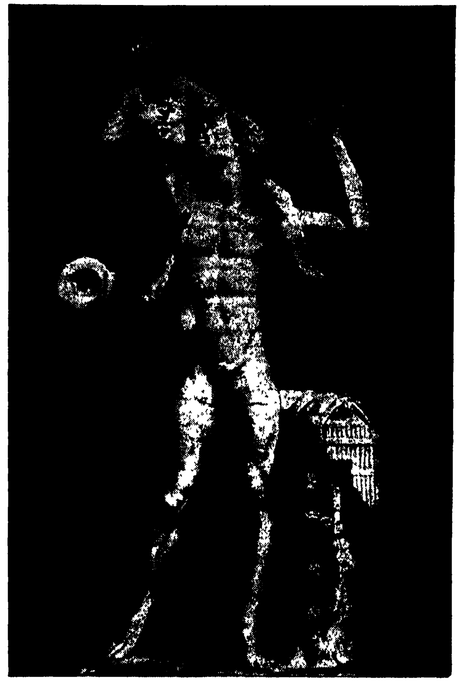


The Artemis of Versailles, or Diana the Huntress, in the Louvre.



The Wounded Warrior—a statue in the style of the Pergamene school.


The Farnese Hercules, by Glycon, an Athenian sculptor.


Bacchus and a Faun, a group in the Naples Museum.

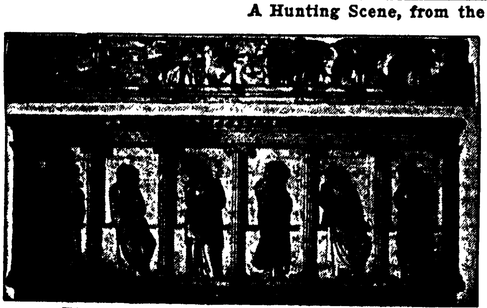

A Greek Warrior, in the National Museum of Rome.

Part of a column from the Temple of Diana at Ephesus.

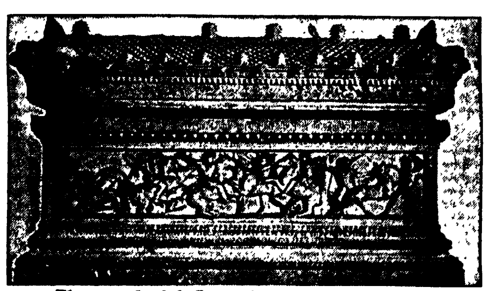
Cupid with a Dolphin.

Orpheus and Eurydice, from the Villa Albani in Rome.

A Hunting Scene, from the Sarcophagus of Alexander.



The Sarcophagus of the Weeping Women.



The wonderful Sarcophagus of Alexander.

The pictures on these pages are reproduced by courtesy of Messrs. Alinari, Anderson, Mansell, and others.

the strongest school of Greek art in later times. The statue of the Dying Gaul and another statue showing the death of a Gaul and his wife, now in Rome, are the most famous that have been discovered of the groups made at the order of Attalus.

The most wonderful work of the Pergamene sculptors—and indeed one of the most wonderful examples of all ancient art—belongs to a later reign. It is a colossal altar that was set up to Zeus on the acropolis in Pergamum. The monument, a great mass of white marble with a base about a hundred feet square, was a most awe-inspiring sight. In its magnificence it seemed terrible to the early Christians, who called it the "Throne of Satan."

The colonnaded court in which the actual altar of sacrifice stood was approached by a broad flight of steps, and two sculptured friezes ran round the whole monument. The larger of the two, broken to admit the staircase, decorated the base of the building; the smaller was set on the inside of the colonnade.

THE STORY TOLD IN THE WONDERFUL PERGAMENE FRIEZE

A group of German archæologists dug up about three hundred feet of the greater frieze, and this most imposing piece of sculpture, with figures six feet high, is now in the Berlin Museum. The story of the frieze is a contest between the giants and the gods, picturing in an allegory the struggles between the Gauls and the Asiatic Greeks. The fragment of Athene and the young giant, already mentioned, is typical of the kind of work put into this marvelous frieze. It must have been a magnificent sight—a triumph of composition wherein groups of vivid and heroic figures are flung, as if they had been alive and the marble had petrified them.

In this work at Pergamum we can see the last stage of Greek art. The frieze of the Parthenon is serene and grand, and reminds one of music; the frieze of the Zeus altar is agitated and grand, and reminds one of horses stampeding. Between these two come the delicate grace of Praxiteles and the robust strength of Lysippus and Scopas.

Again we have reason to lament because so little really of Hellenistic art has survived the centuries. Spoliation by enemy peoples, earthquakes and natural ruin are responsible for a tremendous loss. Still, we are more fortunate than were our forefathers a hundred years ago, for since their time excavations have given us the Elgin marbles and the Pergamene marbles, and many other treasures.

One magnificent thing, also said by the ancients to be one of the seven wonders of the world, is entirely lost to us, and that is the Colossus of Rhodes, a gigantic bronze statue 105 feet high, by Chares, a Rhodian sculptor. It was twelve years in the making, and only sixty years after it was set up it was shattered beyond repair in an earthquake.

A few isolated statues we know by means of marble copies from the work of the later Greeks. One is the Apollo called the Belvedere, from the Belvedere in the Vatican, where it stands. Others are the head of Apollo in the British Museum, the Centaur and Eros, the Artemis of Versailles, and the Borghese Warrior, by Agasias, a sculptor of Ephesus. The last three groups are in the Louvre. Another fine example is the figure of Antioch, in the Vatican, the work of a pupil of Lysippus called Eutychides.

It is very interesting to see in this last period of Greek art the development of the use of the child in sculpture. Until the time of Alexander few child figures of any merit appear. In the third century children began to take their place as subjects for sculpture, and were shown in the proportions of children, instead of being presented as tiny men; from this advancement came the chubby little cupids which later on figured so much in art.

THE FIRST ARTIST TO INTRODUCE CHILDREN INTO SCULPTURE

A sculptor called Boethus, of Carthage, in the third century B.C., seems to have been the first artist to take children seriously as subjects for sculpture, and his work counts as the beginning of a movement. There are several marble copies of his statues in existence. One most delightful example, called The Boy and the Goose, is in the Louvre. It shows a fat little child struggling with a goose about as big as himself. He has seized the bird tightly by the neck, and, if we can guess from the face of the goose, it is complaining bitterly.

This little statue is all the more interesting because it is an illustration of Greek home life, where the goose was a family friend, the playmate of the chil-

dren, and was loved and tormented by them, in the same way that the domestic cat is to-day.

Greek art was not allowed by Fate to die out on its own soil; it was ruthlessly transplanted, and the spoilers were the Romans. When the Roman Empire rose in the West the sculpture of Greece entered on its last phase—called, in art, Græco-Roman. Artists from Athens and Asia Minor migrated to Italy to work for the great conquerors, and, as leading Roman citizens and officials alike had a passion for statues of the gods of Greece, to which they gave Latin names, a veritable forest of statues grew up all through the Empire.

THE CENTURIES OF PLUNDER OF THE NOBLE TREASURES OF GREECE

That was what we might call a reasonable development. It was natural for conquerors to commandeer the best work of the conquered peoples. We find it harder to forgive the wholesale plunder of Greek sculpture that went on for centuries. Generally speaking, the Romans stole statues and carried them away, not so much because they could not bear to leave such beautiful objects behind as because they were proud of their spoil and wanted to parade it just as they did wild beasts from Africa.

The art of Greece—the work of a people whose whole soul was sensitive to beauty—therefore became part of the triumph of Greece's conquerors, who in comparison with the Greeks seemed to have no soul at all, no sensitiveness. People speak of the beauty of Greece, the strength of Rome. We can scarcely understand the extent to which the Hellenistic countries were despoiled. It is said that one general alone carried off from a place in Asia Minor 785 statues in bronze and 230 in marble. It was a common thing for a military official to devote one day of his triumphal procession to the display of "captured" statuary. And the robbery was not only on a huge scale like this: Greece lost much of her best work through the quiet and unnoticed and ceaseless plunder of private persons.

For a long time Athens, Delphi and Olympia, the sacred places of the Greek religion, were left untouched, but the day came when the spoilers entered those last strongholds of art. Nero carried off from Delphi alone 500 bronze statues. During the great fire of Rome a vast number of these lovely things were destroyed.

But not all the Romans collected art works as spoil; some appreciated them for their own sake, and it is said that a number of houses of great Roman citizens were rich beyond thought in beautiful statuary, bronzes, silver, and gilt objects from the East. We have learned something of this since Herculaneum and Pompeii, which were buried by an eruption of Vesuvius in A.D. 79, have been dug out of their lava bed. The homes of ordinary citizens have been laid bare—houses which were treasure stores of art.

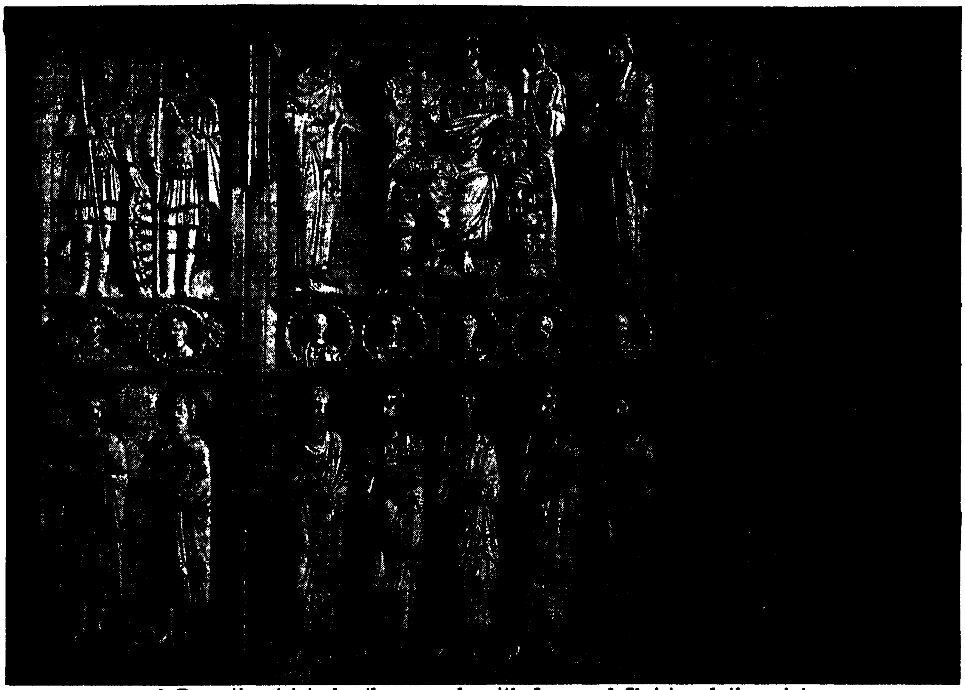
Greek art necessarily overshadowed any work of amateur Roman artists, but a native style grew up nevertheless. It was marked, as one would expect, by a strength which sometimes bordered on brutality, and its chief interest for us lies in the portrait sculpture and reliefs. In both these classes of Roman art the object portrayed is of more interest than the work. The reliefs are historical documents of tremendous interest, as they are mainly concerned with the triumphal processions and doings of Roman generals. In some of them the work is realistic and good. The two best-known examples of this relief work are on the Arch of Titus and on Trajan's Column.

Portrait statues were common in every household of note. Two fine specimens are the head of Augustus, in the Vatican, and Julius Cæsar, in the British Museum.

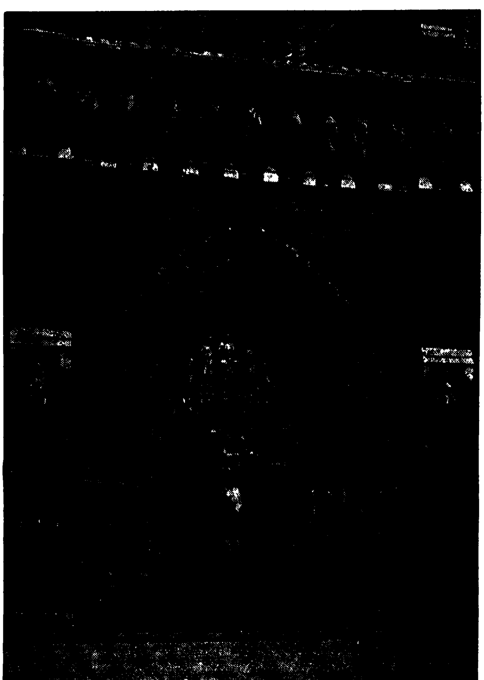
THE AWAKENING OF INTEREST IN GREEK ART IN THE REIGN OF HADRIAN

The influence of Greece came and went during the generations of the development and fulfillment of native Roman art. The best examples of work actually done in Italy by Greek sculptors are the Farnese Hercules by Glycon, the Athenian; the Venus Genetrix by Arcesilaus; and the Orestes and Electra group by Pasiteles.

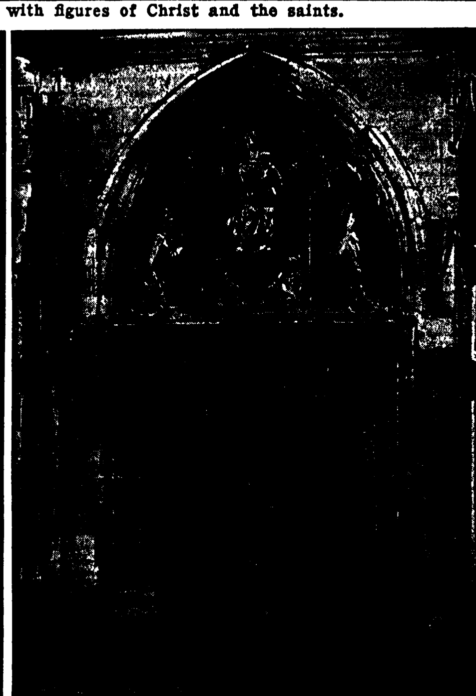
A revival of Greek interest came when Roman art was failing, in the reign of Hadrian. This emperor tried in his own person to atone for many of the sins of ancient Rome. He was a real lover of art, and spent an enormous energy and wealth in building monuments and setting up statuary in many parts of the empire. He caused some really fine copies of Greek masterpieces to be made, and under his influence art in Italy went through a period of revival.



A Byzantine triptych—three panels with figures of Christ and the saints.



The Gothic sculptures round the doorway of Notre Dame in Paris.



Figures over the door of the Gothic chapel of Amboise Castle, in France.

Some of the most interesting sculpture of the time is concerned with the beautiful Antinous, Hadrian's devoted friend. This youth, the story says, offered himself as a sacrifice when Hadrian was journeying through Egypt, drowning himself in the Nile in obedience to a mysterious Egyptian law which demanded that a life should be given as hostage for the emperor's safe passage. Hadrian did the best he could in return for such devotion; he caused statues of Antinous to be set up in honor in the chief places of the empire. Hence the number of busts and reliefs immortalizing the beautiful Antinous. They had a faint echo of the Greek manner, but were spoiled by Roman heaviness. The best is a relief in the Villa Albani, Rome.

THE DECLINE OF ROMAN ART AND THE RISE OF BYZANTINE ART

Within two hundred years after Christ Roman art in Italy was spent. In the Eastern Empire a certain amount of work was done, touched more with Persian than with Hellenic influence. In the meantime Christianity was growing, and when Constantine became Christian and pronounced the Roman Empire Christian, another change passed across the world's face. Constantine, we remember, re-divided the empire and moved his capital from Rome to Byzantium, a town which had already passed through many phases and was destined, under its new name of Constantinople, to be the centre of a peculiar history. There, toward the fifth century, sprang up a new art, known as Byzantine.

Two hundred years later a powerful sect of early Christians denounced "images," or sculptured forms of human beings, as wicked, and while their influence held—for a good part of a century—a general destruction of statuary took place. Byzantine art never recovered from this blow, and in all lands swayed by the religion of Jesus Christ sculpture ceased to be practiced.

Presently the ban was raised, and in the fullness of time that which Christianity had destroyed Christianity built up again, but in a new manner. For some four thousand years Eastern art had dominated the world, while much of Europe was in a state of savagery. Now the old forms of art, Egyptian, Persian, Greek and Roman, were all passed away, dead—or, if not dead, incapable of a revival—and Northern and Western Europe came forward to supply a new art.

From being poor and despised, the "new" religion was now rich, the friend of kings; and as in the early days she had had no covering for her head, she began now to use her freedom and wealth in building churches and cathedrals. Those in Western Europe were called Romanesque, those in Eastern and Northern Europe, Gothic. The Romanesque churches were built largely by monks, who also chiseled what decorative sculpture was designed for the ornamentation of the buildings. It took the form of reliefs of little figures, rather heavy and stiff, in the upper round part of the porches and about the columns.

North of the Alps the Gothic movement was expressing itself in Christian architecture of another kind. The architects of those days were sculptors and designers also, and the workmen they called in to fulfill their orders formed themselves into guilds and became a great power. The marvelous reliefs and figures in the cathedrals of Paris, Chartres, Amiens and Rheims were carved by the first geniuses of the new art.

THE EARLY GOTHIC ART WHICH IS BEAUTIFUL IN ITS SIMPLICITY

We shall be considering presently, from the point of view of architecture, these fairy-like marvels—early Gothic cathedrals and churches. The statuary that adorned them was part of the architecture, part of the design. This period of architectural sculpture had qualities which never came again. The early Gothic statuary was simple and happy. Smiling virgins and happy Christs and saints looked down from the niches of the porches, the galleries, the choir-stalls. An essential difference from Greek art was already noticeable: the nude figure had gone, the draped statuette had come.

To this early and delightful period of Gothic ornament belong also a great mass of carved ivories and little walnut statues of Christ and his mother, and little alabaster reliefs. It was a new art, fresh, obeying no ancient rule save that of purity and suitability to the purpose. When we look at these cathedral porches we are amazed. This early Gothic sculpture is a great and mighty movement in itself—a miracle; the world has seen nothing like it before or since.

THE NEXT STORY OF THE FINE ARTS IS ON PAGE 4603

The Bell of Atri

By HENRY WADSWORTH LONGFELLOW (1807-1882)

In this poem, Longfellow tells with sympathy and charm one of the ancient legends that cluster about the little towns of Italy.

AT ATRI, in Abruzzo, a small town
Of ancient Roman date, but scant renown,
One of those little places that have run
Half up the hill, beneath a blazing sun,
And then sat down to rest, as if to say,
"I climb no farther upward, come what may,"
The Re Giovanni, now unknown to fame,
So many monarchs since have borne the name,
Had a great bell hung in the market-place
Beneath a roof, projecting some small space,
By way of shelter from the sun and rain.
Then rode he through the streets with all his train,
And, with a blast of trumpets loud and long,
Made proclamation, that whenever wrong
Was done to any man, he should but ring
The great bell on the square, and he, the King,
Would cause the Syndic to decide thereon.
Such was the proclamation of King John.

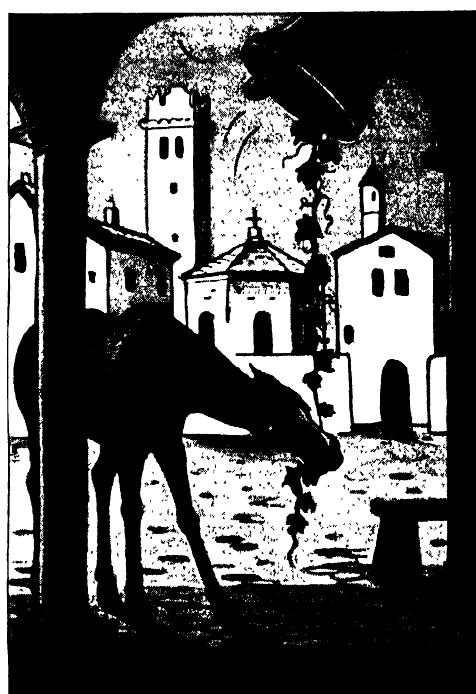
How swift the happy days in Atri sped,
What wrongs were righted need not here be said.
Suffice it that, as all things must decay,
The hempen rope at length was worn away,
Unraveled at the end, and, strand by strand,
Loosened and wasted in the ringer's hand,
Till one, who noted this in passing by,
Mended the rope with braids of briony,
So that the leaves and tendrils of the vine
Hung like a votive garland at a shrine.

By chance it happened that in Atri dwelt
A knight, with spur on heel and sword in belt,
Who loved to hunt the wild boar in the woods,
Who loved his falcons with their crimson hoods,
Who loved his hounds and horses, and all sports,
And prodigalities of camps and courts;
Loved, or had loved them; for at last, grown old,
His only passion was the love of gold.

He sold his horses, sold his hawks and hounds,
Rented his vineyards and his garden grounds,
Kept on one steed, his favorite steed of all,
To starve and shiver in a naked stall,
And day by day sat brooding in his chair,
Devising plans how best to hoard and spare.

At length he said: "What is the use or need
To keep at my own cost this lazy steed,
Eating his head off in my stables here,
When rents are low and provender is dear?
Let him go feed upon the public ways;
I want him only for the holidays."
So the old steed was turned into the heat
Of the long, lonely, silent, shadeless street;
And wandered in suburban lanes forlorn,
Barked at by dogs, and torn by briar and thorn.

One afternoon, as in that sultry clime
It is the custom in the summer-time,
With the bolted doors and window-shutters closed,
The inhabitants of Atri slept or dozed;
When suddenly upon their senses fell
The loud alarum of the accusing bell!
The Syndic started from his deep repose,



Turned on his couch, and listened, and then rose
And donned his robes, and with reluctant pace
Went panting forth into the market-place,
Where the great bell upon its crossbeam swung,
Reiterating with persistent tongue,
In half-articulate jargon, the old song:
"Someone hath done a wrong, hath done a wrong!"

But ere he reached the belfry's light arcade
He saw, he thought, beneath its shade,
No shape of human form of woman born,
But a poor steed, dejected and forlorn,
Who, with uplifted head and eager eye,
Was tugging at the vines of briony.
"Domeneddio!" cried the Syndic straight,
"This is the Knight of Atri's steed of state!
He calls for justice, being sore distressed,
And pleads his cause as loudly as the best!"

Meanwhile from street and lane a noisy crowd
Had rolled together like a summer cloud,
And told the story of the wretched beast
In five-and-twenty different ways at least,
With much gesticulation and appeal
To heathen gods, in their excessive zeal.
The knight was called and questioned; in reply
Did not confess the fact, did not deny;
Treated the matter as a pleasant jest,
And set at naught the Syndic and the rest,
Maintaining, in an angry undertone,
That he should do what pleased him with his own.

And thereupon the Syndic gravely read
The proclamation of the King; then said:
"Pride goeth forth on horseback grand and gay,
But cometh back on foot, and begs its way;
Fame is the fragrance of heroic deeds,
Of flowers of chivalry and not of weeds!
These are familiar proverbs, but I fear
They never yet have reached your knightly ear.
What fair renown, what honor, what repute
Can come to you from starving this poor brute?
He who serves well and speaks not, merits more
Than they who clamor loudest at the door.
Therefore the law decrees that as this steed
Served you in youth, henceforth you shall take heed
To comfort his old age, and to provide
Shelter in stall, and food and field beside."

The knight withdrew, abashed; the people all
Led home the steed in triumph to his stall.
The King heard and approved, and laughed in glee,
And cried aloud: "Right well it pleaseth me!
Church-bells at best but ring us to the door,
But go not in to Mass; my bell doth more:
It cometh into court and pleads the cause
Of creatures dumb, and unknown to the laws;
And this shall make, in every Christian clime,
The bell of Atri famous for all time."

The Leak in The Dyke

By PHOEBE CARY (1824-1871)

THE good dame looked from her cottage
  At the close of the pleasant day,
And cheerily called to her little son
  Outside the door at play:
"Come, Peter, come! I want to see you go,
  While there is light to see,
To the hut of the blind old man who lives
  Across the dyke, for me;
And take these cakes I made for him—
  They are hot and smoking yet.
You have time enough to go and come
  Before the sun is set."

Then the good wife turned to her labor,
  Humming a simple song,
And thought of her husband working hard
  At the sluices all day long;
And set the turf a-blazing,
  And brought the coarse black bread,
That he might find a fire at night,
  And find the table spread.

And Peter left the brother
  With whom all day he had played,
And the sister who had watched their sports
  In the willow's tender shade;
And told them they'd see him back before
  They saw a star in sight,
Though he wouldn't be afraid to go
  In the very blackest night!

For he was a brave, bright fellow,
  With eye and conscience clear;
He could do whatever a boy might do,
  And he had not learned to fear.
Why, he wouldn't have robbed a bird's nest,
  Nor brought a stork to harm,
Though never a law in Holland
  Had stood to stay his arm!

And now, with his face all glowing,
  And eyes as bright as the day

With the thoughts of his pleasant errand,
He trudged along the way.
And soon his joyous prattle
Made glad a lonesome place—
Alas! if only the blind old man
Could have seen that happy face!

Yet he, somehow, caught the brightness
Which his voice and presence lent;
And he felt the sunshine come and go
As Peter came and went.

And now, as the day was sinking,
And the winds began to rise,
The mother looked from her door again,
Shading her anxious eyes;
And saw the shadows deepen,
And birds to their homes come back;
And never a sign of Peter
Along the level track.
But she said: "He will come at morning,
So I need not fret or grieve—
Though it isn't like my boy at all
To stay without my leave."

But where was the child delaying?
On the homeward way was he,
And across the dyke while the sun was up
An hour above the sea.
He was stooping now to gather flowers,
Now listening to the sound,
As the angry waters dashed themselves
Against their narrow bound.
"Ah! well for us," said Peter,
"That the gates are good and strong,
And my father tends them carefully,
Or they would not hold you long!
"You're a wicked sea," said Peter;
"I know why you fret and chafe;
You would like to spoil our lands and homes,
But our sluices keep you safe!"

But hark! Through the noise of the waters
Comes a low, clear, trickling sound;
And the child's face pales with terror,
And his blossoms drop to the ground.
He is up the bank in a moment,
And, stealing through the sand,
He sees a stream not yet so large
As his slender, childish hand.
'Tis a leak in the dyke! He is but a boy,
Unused to fearful scenes;
But, young as he is, he has learned to know
The dreadful thing that means.

A leak in the dyke! The stoutest heart
Grows faint that cry to hear,
And the bravest man in all the land
Turns white with mortal fear:
For he knows the smallest leak may grow
To a flood in a single night;
And he knows the strength of the cruel sea
When loosed in its angry might.

And the boy! he has seen the danger,
And, shouting a wild alarm,

He forces back the weight of the sea
  With the strength of his single arm!
He listens for the joyful sound
  Of a footstep passing nigh;
And he lays his ear to the ground to catch
  The answer to his cry.

And he hears the rough wind blowing,
  And the waters rise and fall,
But never an answer came to him,
  Save the echo of his call.
He sees no hope, no succour—
  His feeble voice is lost;
Yet what shall he do but watch and wait,
  Though he perish at his post!

So, faintly calling and crying
  Till the sun is under the sea,
Crying and moaning till the stars
  Come out for company.
He thinks of his brother and sister,
  Asleep in their safe, warm bed;
He thinks of his father and mother,
  Of himself as dying and dead,
And of how, when the night is over
  They must come and find him at last;
But he never thinks he can leave the place
  Where duty holds him fast.

The good dame in the cottage
  Is up and astir with the light,
For the thought of her little Peter
  Has been with her all night.
And now she watches the pathway,
  As yestereve she had done;
But what does she see so strange and black
  Against the rising sun?
Her neighbors are bearing between them
  Something straight to her door—
The child is coming home, but not
  As he ever came before!

"He is dead!" she cries. "My darling!"
  And the startled father hears,
And comes and looks the way she looks,
  And fears the thing she fears.
Till a glad shout from the bearers
  Thrills the stricken man and wife:
"Give thanks, for your son has saved our land,
  And God has saved his life!"
So, there in the morning sunshine,
  They knelt about the boy;
And every head was bared and bent
  In tearful, reverent joy.

'Tis many a year since then; but still,
  When the sea roars like a flood,
Their boys are taught what a boy can do
  Who is brave, and true, and good.
For every man in that country
  Takes his son by the hand,
And tells him of little Peter,
  Whose courage saved the land.

They have many a valiant hero,
  Remembered through the years;
But never one whose name so oft
  Is named with loving tears.
And his deed shall be sung by the cradle,
  And told to the child on the knee,
So long as the dykes of Holland
  Divide the land from the sea!

At last the people in a body to the Town Hall came flocking.

The Pied Piper of Hamelin

By Robert Browning (1812-1889)

This poem tells one of the many legends about European places.

Hamelin Town's in Brunswick,
By famous Hanover city;
The river Weser, deep and wide,
Washes its walls on the southern side.
A pleasanter spot you never spied;
But, when begins my ditty,
Almost five hundred years ago,
To see the townsfolk suffer so
From vermin, was a pity.

Rats!
They fought the dogs, and killed the cats,
And bit the babies in the cradles,
And ate the cheese out of the vats,
And licked the soup from the cooks' own ladles,
Split open the kegs of salted sprats,
Made nests inside men's Sunday hats,
And even spoiled the women's chats,
By drowning their speaking
With shrieking and squeaking
In fifty different sharps and flats.

At last the people in a body
To the Town Hall came flocking:
" 'Tis clear," cried they, "our Mayor's a noddy;
And as for our Corporation—shocking
To think we buy gowns lined with ermine
For dolts who can't or won't determine
What's best to rid us of our vermin!
You hope, because you're old and obese,
To find in the furry civic robe ease?
Rouse up, sirs! Give your brains a racking
To find the remedy we're lacking,
Or, sure as fate, we'll send you packing!"
At this the Mayor and Corporation
Quaked with a mighty consternation.

An hour they sat in council;
At length the Mayor broke silence:
"For a guilder I'd my ermine gown sell;
I wish I were a mile hence!
It's easy to bid one rack one's brain—
I'm sure my poor head aches again,

I've scratched it so, and all in vain.
Oh, for a trap, a trap, a trap!"
Just as he said this, what should hap
At the chamber door but a gentle tap?
"Bless us!" cried the Mayor, "what's that?"
(With the Corporation as he sat,
Looking little though wondrous fat;
Nor brighter was his eye, nor moister
Than a too-long-opened oyster,
Save when at noon his paunch grew mutinous
For a plate of turtle green and glutinous.)
"Only a scraping of shoes on the mat?
Anything like the sound of a rat
Makes my heart go pit-a-pat!"

"Come in!" the Mayor cried, looking bigger:
And in did come the strangest figure!
His queer long coat from heel to head
Was half of yellow, and half of red;
And he himself was tall and thin,
With sharp blue eyes, each like a pin,
And light, loose hair, yet swarthy skin,
No tuft on cheek nor beard on chin,
But lips where smiles went out and in;
There was no guessing his kith and kin:
And nobody could enough admire
The tall man and his quaint attire.
Quoth one: "It's as my great-grandsire,
Starting up at the Trump of Doom's tone,
Had walked this way from his painted tomb-
stone!"

He advanced to the council-table:
And, "Please your honors," said he, "I'm able,
By means of a secret charm, to draw
All creatures living beneath the sun,
That creep or swim or fly or run,
And after me so as you never saw:
And I chiefly use my charm
On creatures that do people harm,
The mole and toad and newt and viper;
And people call me the Pied Piper."
(And here they noticed round his neck
A scarf of red and yellow stripe,
To match with his coat of the self-same check;
And at the scarf's end hung a pipe,
And his fingers, they noticed, were ever
straying
As if impatient to be playing
Upon his pipe as low it dangled
Over his vesture, so old-fangled.)
"Yet," said he, "poor piper as I am,
In Tartary I freed the Cham
Last June, from his huge swarms of gnats;
I eased in Azia the Nizam
Of a monstrous brood of vampire-bats:
And, as for what your brain bewilders,
If I can rid your town of rats,

"If I can rid your town of rats, will you give me a thousand guilders?"

Out of the houses the rats came tumbling.

Will you give me a thousand guilders?"
"One? Fifty thousand!" was the exclamation
Of the astonished Mayor and Corporation.

Into the streets the Piper stept,
  Smiling first a little smile,
As if he knew what magic slept
  In his quiet pipe the while;
Then, like a musical adept,
To blow the pipe his lips he wrinkled,
And green and blue his sharp eyes twinkled
Like a candle flame where salt is sprinkled;
And ere three shrill notes the pipe uttered,
You heard as if an army muttered;
And the muttering grew to a grumbling;
And the grumbling grew to a mighty
    rumbling,
As out of the houses the rats came tumbling.
Great rats, small rats, lean rats, brawny rats,
Brown rats, black rats, grey rats, tawny rats,
Grave old plodders, gay young friskers,
Fathers, mothers, uncles, cousins,
Cocking tails and pricking whiskers,
Families by tens and dozens,
Brothers, sisters, husbands, wives—
Followed the Piper for their lives.
From street to street he piped advancing,
And step for step they followed dancing,
Until they came to the river Weser,
  Wherein all plunged and perished—
Save one who, stout, as Julius Cæsar,
Swam across and lived to carry
  (As he, the manuscript he cherished)
To Rat-land home his commentary:
Which was, "At the first shrill notes of
    the pipe,
I heard a sound as of scraping tripe,
And putting apples, wondrous ripe,
Into a cider-press's gripe:
And a moving away of pickle-tub boards,
And a leaving ajar of conserve-cupboards,
And a drawing the corks of train-oil flasks,
And a breaking the hoops of butter-casks:
And it seemed as if a voice
  (Sweeter far than by harp or by psaltery
Is breathed) called out, 'Oh rats, rejoice!
  The world is grown to one vast drysaltery!
So munch on, crunch on, take your nuncheon,
Breakfast, supper, dinner, luncheon!'
And just as a bulky sugar-puncheon,
All ready staved, like a great sun shone
Glorious scarce an inch before me,
Just as methought it said, 'Come bore me!'—
I found the Weser rolling o'er me."

All the little boys and girls, with rosy cheeks and flaxen curls, and sparkling eyes and teeth like pearls.

You should have heard the Hamelin people
Ringing the bells till they rocked the steeple;
"Go," cried the Mayor, "and get long poles!
Poke out the nests and block up the holes!
Consult with carpenters and builders,
And leave in our town not even a trace
Of the rats!"—when suddenly, up the face
Of the Piper perked in the market-place,
With a "First, if you please, my thousand
guilders!"

A thousand guilders! The Mayor looked blue;
So did the Corporation too.
For Council dinners made rare havoc
With claret, moselle, vin-de-grave, hock;
And half the money would replenish
Their cellar's biggest butt with Rhenish.
To pay this sum to a wandering fellow
With a gipsy coat of red and yellow!
"Beside," quoth the Mayor, with a knowing
wink,
"Our business was done at the river's brink.
We saw with our eyes the vermin sink,
And what's dead can't come to life, I think,
So, friend, we're not the folks to shrink
From the duty of giving you something to
drink,
And a matter of money to put in your poke;
But, as for the guilders, what we spoke
Of them, as you very well know, was in joke,
Beside, our losses have made us thrifty.
A thousand guilders! Come, take fifty!"

The Piper's face fell, and he cried:
"No trifling! I can't wait! beside,
I've promised to visit by dinner-time
Bagdad, and accept the prime
Of the head cook's pottage, all he's rich in,
For having left, in the Caliph's kitchen,
Of a nest of scorpions no survivor:
With him I proved no bargain driver,
With you, don't think I'll bate a stiver!
And folks who put me in a passion
May find me pipe after another fashion."
"How?" cried the Mayor, "d'ye think I'll
brook
Being worse treated than a cook?
Insulted by a lazy ribald
With idle pipe and vesture piebald?
You threaten us, fellow? Do your worst,
Blow your pipe there till you burst!"

Once more he stept into the street
And to his lips again
Laid his long pipe of smooth straight cane;
And ere he blew three notes (such sweet
Soft notes as yet musician's cunning
Never gave the enraptured air)
There was a rustling that seemed like a
bustling
Of merry crowds justling at pitching and
hustling,
Small feet were pattering, wooden shoes
clattering,
Little hands clapping, and little tongues
chattering;
And, like fowls in a farmyard when barley is
scattering,
Out came the children running:
All the little boys and girls,
With rosy cheeks and flaxen curls,
And sparkling eyes and teeth like pearls,

Tripping and skipping, ran merrily after
The wonderful music with shouting and
laughter.

The Mayor was dumb, and the Council stood
As if they were changed into blocks of wood,
Unable to move a step or cry
To the children merrily skipping by,
And could only follow with the eye
That joyous crowd at the Piper's back.
But how the Mayor was on the rack,
And the wretched Council's bosoms beat,
As the Piper turned from the High Street
To where the Weser rolled its waters
Right in the way of their sons and daughters!
However, he turned from South to West,
And to Koppelburg Hill his steps
addressed.
And after him the children pressed;
Great was the joy in every breast.
"He can never cross that mighty top!
He's forced to let the piping drop,
And we shall see our children stop!"
When, lo, as they reached the mountainside,
A wondrous portal opened wide,
As if a cavern was suddenly hollowed;
And the Piper advanced and the children
followed.
And when all were in to the very last,
The door in the mountain-side shut fast.
Did I say all? No! One was lame.
And could not dance the whole of the way;
And in after years, if you would blame
His sadness, he was used to say:
"It's dull in our town since my playmates
left.
I can't forget that I'm bereft
Of all the pleasant sights they see,
Which the Piper also promised me;
For he led us, he said, to a joyous land,
Joining the town and just at hand,
Where waters gushed and fruit-trees grew,
And flowers put forth a fairer hue,
And everything was strange and new.
The sparrows were brighter than peacocks
here,
And their dogs outran our fallow deer,
And honey-bees had lost their stings,
And horses were born with eagles' wings:
And just as I became assured
My lame foot would be speedily cured,
The music stopped and I stood still,
And found myself outside the hill,
Left alone against my will,
To go now limping as before,
And never hear of that country more!"

He turned from South to West, and to Koppelburg Hill his steps addressed; and after him the children pressed.

Opposite the place of the cavern they wrote the story upon a column.

Alas, alas for Hamelin!
  There came into many a burgher's pate
  A text which says, that heaven's gate
  Opes to the rich at as easy rate
As the needle's eye takes a camel in!
The Mayor sent East, West, North, and
    South,
To offer the Piper, by word of mouth,
  Wherever it was men's lot to find him,
Silver and gold to his heart's content,
If he'd only return the way he went,
  And bring the children behind him.
But when they saw 'twas a lost endeavor,
And Piper and dancers were gone for
    ever,
They made a decree that lawyers never
  Should think their records dated duly
If, after the day of the month and year,
These words did not as well appear:
"And so long after what happened here
  On the twenty-second of July,
Thirteen hundred and seventy-six";
And the better in memory to fix
The place of the children's last retreat,
They called it the Pied Piper's Street—
Where anyone playing on pipe or tabor
Was sure for the future to lose his labor.
Nor suffered they hostelry or tavern
  To shock with mirth a street so solemn,
But opposite the place of the cavern
  They wrote the story on a column,
And on the great church window painted
The same, to make the world acquainted
How their children were stolen away;
And there it stands to this very day.
And I must not omit to say
That in Transylvania there's a tribe
Of alien people who ascribe
The outlandish ways and dress
On which their neighbors lay such a stress,
To their fathers and mothers having risen
Out of some subterranean prison
Into which they were trepanned
Long time ago in a mighty band
Out of Hamelin town in Brunswick land,
But how or why, they don't understand.

So, Willy, let you and me be wipers
Of scores out with all men—especially pipers;
And, whether they pipe us free from rats or
    from mice,
If we've promised them aught, let us keep
    our promise!

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Rip Van Winkle

By WASHINGTON IRVING

WHOEVER makes a voyage up the Hudson River will see the famous Catskill Mountains, that are a branch of a still greater range stretching away to the west of the river, swelling up to a noble height, and lording it over the surrounding country. Every change of season, every change of weather, indeed, every hour of the day, produces some change in the magical hues and shapes of these mountains, and they are regarded by all the good wives, far and near, as perfect barometers.

When the weather is quite fair and settled they are clothed in blue and purple, and print their bold outlines on the clear evening sky; but sometimes, when the rest of the landscape is cloudless, they gather a hood of gray vapors about their summits, which, in the last rays of the setting sun, glow and light up like a crown of glory.

In a tiny village at the foot of these fairy mountains there lived many years ago a simple, good-natured fellow of the name of Rip Van Winkle. He was a kind neighbor and an obedient husband, and was a general favorite. The children would shout with joy whenever he approached. He assisted at their sports, made their little playthings, taught

them to fly kites and to shoot marbles, and told them long stories of ghosts, witches and Indians. Whenever he went roaming about the village he was surrounded by a troop of boys and girls hanging on his skirts, clamber-

ing on his back, and playing a thousand tricks on him with impunity, and not a dog would bark at him throughout the neighborhood.

The great failure in Rip's character was his great dislike for all kinds of profitable labor. It could not have been from the want of application or perseverance, for he would sit on a wet rock, with a rod as long and heavy as a Tartar's lance, and fish all day without a murmur, even though he would not be encouraged by a single nibble. He would carry a gun on his shoulder for hours together, trudging through woods and swamps, and up hill and down dale, to shoot a few squirrels or wild pigeons.

He would never refuse to assist a neighbor even in the roughest toil, and was a foremost man at all country frolics for husking Indian corn or building stone fences; the women of the village, too, used to employ him to run their errands, and to do such little odd jobs as their less obliging husbands would not do for them. In a word, Rip was ready to attend to anybody's business but his own; but as to his doing his duty to his family and keeping his farm in order, he found it impossible.

In fact, he declared it was of no use to work on his farm: it was the most unprofitable little piece of ground in the whole country; everything about it went wrong, and would go wrong, in spite of him. His fences were continually falling to pieces; his cow would either go astray or get among the cabbages; weeds were sure to grow quicker in his fields than anywhere else; the rain always made a point of setting in just as he had some outdoor work to do; so that though his estate had dwindled away, acre by acre, under his management, until there was little more left than a mere patch of Indian corn and potatoes, yet it was the worst-conditioned farm in the neighborhood.

His children, too, were as ragged and wild as if they belonged to nobody. His son Rip promised to inherit the habits with the old clothes of his father. He was generally seen trooping like a colt at his mother's heels equipped in a pair of his father's cast-off breeches, which he had much difficulty in holding up with one hand, as a fine lady does her train in bad weather.

Rip Van Winkle, however, was one of those happy mortals who take the world easily, eat white bread or brown, whichever can be got with least thought or trouble, and would rather starve on a penny than work for a dollar. If left to himself, he would have whistled life away in perfect contentment; but his wife kept continually shouting in his ears about his idleness, his carelessness, and the ruin he was bringing on his family.

Rip's sole domestic friend was his dog Wolf, who was as much hen-pecked as his master; for Dame Van Winkle regarded them as companions in idleness, and even looked upon Wolf with an evil eye as the cause of his master's going so often astray.

Times grew worse and worse with Rip Van Winkle as the years rolled on. A tart temper never mellows with age, and a sharp tongue is the only edged tool that grows keener with constant use. For a long while he used to console himself, when driven from home, by frequenting a kind of club of the sages, philosophers and other idle people of the village, which held its sessions on a bench before a small inn that had for its sign a ruddy por-

trait of His Majesty King George III.

The opinions of this little band were completely controlled by Nicholas Vedder, a patriarch of the village and landlord of the inn, at the door of which he took his seat from morning till night, just moving sufficiently to avoid the sun and keep in the shade of a large tree, so that the neighbors could tell the hour by his movements as accurately as by a sundial. It is true he was rarely heard to speak, but smoked his pipe incessantly. His friends, however, perfectly understood him, and knew how to gather his opinions.

When anything that was read or related displeased him, he was observed to smoke vehemently, and to send forth short, frequent and angry puffs; but when pleased, he would inhale the smoke slowly and tranquilly, and emit it in light and placid clouds; and sometimes, taking the pipe from his mouth and letting the fragrant vapor curl about his nose, would gravely nod his head in token of perfect approbation.

From even this stronghold the unlucky Rip was at length routed by his nagging wife, who would suddenly break in upon the tranquillity of the assemblage and abuse the members for their laziness. Nor was that august personage, Nicholas Vedder himself, sacred from the daring tongue of this terrible woman, who charged him outright with encouraging her husband in his habits of idleness.

Poor Rip was at last reduced almost to despair, and his only alternative to escape from the labor of the farm and clamor of his wife was to take gun in hand and stroll away into the woods. Here he would sometimes seat himself at the foot of a tree and share the contents of his wallet with Wolf, with whom he sympathized as a fellow-sufferer in persecution.

In a long ramble of the kind, on a fine autumnal day, Rip had unconsciously scrambled to one of the highest parts of the Catskill Mountains. He was after his favorite sport of squirrel-shooting, and the still solitudes had echoed and re-echoed with the reports of his gun. Panting and fatigued, he threw himself, late in the afternoon, on a green knoll covered with mountain herbage that crowned the brow of a precipice From an opening between the trees he could overlook all the lower country for many a mile of rich woodland. He saw at a distance the lordly Hudson far, far below him, moving on its silent, majestic course, with the reflection of a purple cloud, or the sail of a lagging bark, here and there sleeping on its glassy bosom, and at last losing itself in the blue highlands.

For some time Rip lay musing on this scene; evening was gradually advancing; the mountains began to throw their long, blue shadows over the valleys; he saw that it would be dark long before he could reach the village, and he heaved a heavy sigh when he thought of encountering the terrors of Dame Van Winkle.

As he was about to descend he heard a voice from a distance hallooing: "Rip Van Winkle! Rip Van Winkle!" He looked round, but could see nothing but a crow winging its soli-

tary flight across the mountain. He thought his fancy must have deceived him, and turned again to descend, when he heard the same cry ring through the still evening air: "Rip Van Winkle! Rip Van Winkle!" At the same time Wolf bristled up his back, and giving a loud growl, skulked to his master's side, looking fearfully down into the glen.

Rip now felt a vague dread stealing over him; he looked anxiously in the same direction and perceived a strange figure slowly toiling up the rocks and bending under the weight of something he carried on his back. He was surprised to see any human being in this lonely and unfrequented place; but supposing it to be someone of the neighborhood in need of his assistance, he hastened down to help.

On nearer approach he was still more surprised at the singularity of the stranger's appearance. He was a short, squarely built old fellow, with thick, bushy hair and a grizzled beard. His dress was of the antique Dutch fashion—a cloth jerkin strapped round the waist; several pairs of breeches, the outer one of ample volume, decorated with rows of buttons down the sides, and bunches of ribbon at the knees. He bore on his shoulder a stout keg that seemed full of liquor, and made signs for Rip to approach and assist him with the load. Though rather shy and distrustful of this new acquaintance, Rip complied with his usual alacrity, and mutually assisting each other, they clambered up a narrow gully, apparently the dry bed of a mountain torrent.

As they ascended, Rip every now and then heard long, rolling peals, like distant thunder, that seemed to issue out of a deep ravine, or cleft, between lofty rocks, toward which their rugged path conducted. He paused for an instant, but supposing it to be the muttering of one of those fitful thunder-showers which often take place in mountain heights, he proceeded.

Passing through the ravine, they came to a hollow like a small amphitheatre, surrounded by perpendicular precipices, over the brinks of which tall trees shot their branches, so that they only caught glimpses of the azure sky and the bright evening cloud. During the whole time Rip and his companion had labored on in silence, for though the former marveled greatly what could be the object of carrying a keg of liquor up this wild mountain, yet there was something strange about the unknown that inspired awe and checked familiarity.

On entering the amphitheatre new objects of wonder presented themselves. On a level spot in the centre was a company of odd-looking old men playing at ninepins. They were dressed in a quaint, outlandish fashion—some wore short doublets, others jerkins, with long knives in their belts, and most of them had enormous breeches, of similar style to that of the guide's.

Their visages, too, were peculiar—one had a large head, broad face, and small, piggish eyes; the face of another seemed to consist entirely of nose, and was surmounted by a black sugar-loaf hat, set off with a little red cock's tail. They all had beards of various shapes and colors.

There was one who seemed to be the commander. He was a stout old gentleman with a weather-beaten countenance; he wore a laced doublet, broad belt and hanger, high-crowned hat and feather, red stockings and high-heeled shoes with roses in them.

The whole group reminded Rip very much of the figures in an old Flemish painting that he had seen in the parlor of Dominie Van Shaick, the village parson, and which had been brought over from

Holland at the time of the settlement.

What seemed particularly odd to Rip was that, though these folks were evidently amusing themselves, yet they maintained the gravest faces, the most mysterious silence, and were, withal, the most melancholy party of pleasure he had ever witnessed. Nothing interrupted the stillness of the scene but the noise of the balls, which, whenever they were rolled, echoed along the mountains like thunder rumbling in the far distance.

As Rip and his companion approached them they suddenly stopped their play and stared at him with such fixed, statue-like gaze and such strange, uncouth countenances, that his heart turned within him and his knees smote together. His companion now emptied the contents of the keg into large flagons and made signs to him to wait upon the company. He obeyed with fear and trembling; they drank the liquor in profound silence and then they returned to their game.

By degrees Rip's awe and fear subsided. He even ventured, when no eye was fixed upon him, to taste the beverage, which he found very good. He was naturally a thirsty soul, and was soon tempted to repeat the draft. One taste provoked another, and he repeated his visits to the flagon so often that at length his senses were overpowered, his eyes swam in his head, his head gradually declined, and he fell into a deep sleep.

On waking, he found himself on the green knoll whence he had first seen the old man of the glen. He rubbed his eyes—it was a bright, sunny morning. The birds were hopping and twittering among the bushes, and the eagle was wheeling aloft and breasting the pure mountain breeze.

"Surely," thought Rip, "I have not slept here all night." He recalled the occurrences before he fell asleep—the strange man with a keg of liquor, the mountain ravine, the wild retreat among the rocks, the woebegone party at ninepins, the flagon.

"Oh, that wicked flagon!" thought Rip. "What excuse shall I make to Dame Van Winkle?"

He looked round for his gun, but in place of the clean, well-oiled weapon he found an old firelock lying by him, the barrel incrusted with rust, the lock falling off, and the stock worm-eaten. He now suspected that the grave men of the mountain had played a trick upon him, and having dosed him with liquor, had robbed him of his gun. Wolf, too, had disappeared, but he might have strayed away after a squirrel or partridge. He whistled after him and shouted his name, but all in vain; the echoes repeated his whistle and shout, but no dog was to be seen.

He determined to revisit the scene of the last evening's gambol, and if he met with any of the party, to demand his dog and gun. As he rose to walk, he found himself stiff in the joints and wanting in his usual activity. "These mountain beds do not agree with me," thought Rip; "and if this frolic should lay me up with a touch of rheumatism, I shall have a bad time with Dame Van Winkle."

With some difficulty he got down into the glen: he found the gully up which he and his companion had ascended the preceding evening; but, to his astonishment, a mountain stream was now foaming down it, leaping from rock to rock and filling the glen with babbling murmurs. He, however, tried to scramble up its sides, working his toilsome way through thickets of birch and witchhazel, and sometimes tripped over the wild grapevines that twisted their tendrils from tree to tree and spread a kind of network in his path.

At length he reached the place where the ravine had opened through the cliffs to the amphitheatre; but no traces of such opening remained. The rocks presented a high, impenetrable wall, over which the torrent came tumbling in a sheet of feathery foam and fell into a broad, deep basin black from the shadows of the surrounding forest.

Here, then, poor Rip was brought to a

stand. He again called and whistled after his dog; he was answered only by the cawing of a flock of idle crows sporting high in air about a dry tree that overhung a sunny precipice. What was to be done? The morning

was passing away, and Rip felt famished for want of his breakfast. He grieved to give up his dog and his gun, he dreaded to meet his wife; but it would not do to starve among the mountains. He shook his head, and with a heart full of trouble and anxiety shouldered his rusty firelock and turned his steps toward his distant home.

II

As Rip Van Winkle approached the village after his long sleep, he met a number of people, but none whom he knew, which somewhat surprised him. Their dress, too, was of a different fashion from that to which he was accustomed. They all stared at him with equal marks of surprise, and whenever they cast their eyes upon him invariably stroked their chins. The constant recurrence of this gesture induced Rip involuntarily to do the same, when, to his astonishment, he found his beard had grown a foot long!

He had now entered the outskirts of the village. A troop of strange children ran at his heels, hooting after him and pointing at his gray beard. The very village was altered: it was larger and more populous. There were rows of houses which he had never seen before, and those which had been his familiar haunts had disappeared. Strange names were over the doors, strange faces at the windows —everything was strange and unfamiliar to poor Rip.

His mind was now troubled: he began to doubt whether both he and the world around him were not bewitched. Surely this was his native village, which he had left but the day before. There stood the Catskill Mountains; there ran the silvery Hudson at a distance; there was every hill and dale precisely as it had always been.

Rip was sorely perplexed. "That flagon last night," thought he, "has addled my poor head sadly!"

It was with some difficulty that he found the way to his own house, which he approached with silent awe, expecting every moment to hear the shrill voice of Dame Van Winkle. He found the house gone to decay— the roof fallen in, the windows shattered, and the doors off the hinges. A half-starved dog that looked like Wolf was skulking about it. Rip called him by name, but the dog snarled, showed his teeth, and passed on. This was an unkind cut indeed. "My very dog," sighed poor Rip, "has forgotten me!"

He entered the house, which, to tell the truth, Dame Van Winkle had always kept in neat order. It was empty, forlorn and apparently abandoned. The desolateness overcame all his fears; he called loudly for his wife and children; the lonely chambers rang for a moment with his voice, and then all again was silence.

He now hurried forth and hastened to his old resort, the village inn, but it, too, was gone. A large rickety wooden building stood in its place, with great gaping windows, some of them broken and mended with old hats and petticoats, and over the door was painted: "The Union Hotel, by Jonathan Doolittle." Instead of the great tree that used to shelter the quiet little Dutch inn of old there was now reared a tall, naked pole, with something on the top that looked like a red nightcap, and from it was fluttering a flag on which was a singular assemblage of stars and stripes.

All this was strange and incomprehensible. He recognized on the sign, however, the ruby face of King George, under which he had

smoked so many a peaceful pipe; but even this was singularly altered. The red coat was changed for one of blue and buff, a sword was held in the hand instead of a sceptre, the head was decorated with a cocked hat, and underneath was painted in large characters: "General Washington."

There was, as usual, a crowd of folk about the door, but none that Rip recollected. The very character of the people seemed changed. There was a busy, bustling tone about it, instead of the accustomed drowsy tranquillity.

Rip looked in vain for the sage Nicholas Vedder, with his broad face, double chin and long pipe, issuing clouds of tobacco-smoke instead of idle speeches; or Van Bummel, the schoolmaster, doling forth the contents of an ancient newspaper. In place of these a lean, pale-looking fellow, with his pockets full of hand-bills, was talking vehemently about the rights of citizens, elections, members of Congress, liberty, Bunker Hill, heroes of Seventy-six, and other words which were a perfect puzzle to the bewildered Van Winkle.

The appearance of Rip, with his long, grizzled beard, his rusty weapon, his uncouth dress, and an army of women and children at his heels, soon attracted the attention of the tavern politicians. They crowded round him, eyeing him from head to foot with great curiosity. The orator bustled up to him, and, drawing him partly aside, inquired on which side he voted. Rip stared in vacant stupidity. Another short but busy little fellow pulled him by the arm, and, rising on tiptoe, inquired in his ear whether he was Federal or Democrat.

Rip was equally at a loss to comprehend the question, when a knowing, self-important old gentleman made his way through the crowd, pushing them to the right and left with his elbows as he passed, and planting himself before Van Winkle, with one hand on his side, the other resting on his cane, his keen eyes penetrating, as it were, into Rip's very soul, demanded, in an austere tone, what brought him to the election with a gun on his shoulder and a mob at his heels, and whether he meant to breed a riot in the village.

"Alas, gentlemen," cried Rip, somewhat dismayed, "I am a poor, quiet man, a native of the place, and a loyal subject of the king, God bless him!"

Here a general shout burst from the bystanders: "A Tory! A Tory! A spy! A refugee! Away with him!" It was with great difficulty that the self-important man restored order; and having assumed a greater austerity of brow, demanded again of the unknown culprit what he came there for and whom he was seeking. The poor man humbly assured him that he meant no harm, but merely came there in search of some of his neighbors who used to keep about the tavern.

"Well, who are they? Name them."

Rip bethought himself a moment, and inquired: "Where's Nicholas Vedder?"

There was a silence for a little while; everyone looked blank, and then an old man replied in a thin, piping voice: "Nicholas Vedder! Why, he is dead and gone these eighteen years! There was a wooden tombstone in the

churchyard that used to tell all about him, but that's rotten and gone, too, and few here remember him."

"Where's Brom Dutcher?"

"Oh, he went off to the army in the beginning of the war! Some say he was killed at the storming of Stony Point; others say he was drowned in a squall at the foot of Antony's Nose. I don't know—he never came back again."

"Where's Van Bummel, the schoolmaster?"

"He went off to the wars, too—was a great militia general, and is now in Congress."

Rip was grieved to hear of these sad changes and grieved to find himself so much alone in the world. Every answer puzzled him, too, by treating of such enormous lapses of time, and of matters which he could not understand —war, Congress, Stony Point. He had no courage to ask after any more friends, but cried out in despair: "Does nobody here know Rip Van Winkle?"

"Oh, Rip Van Winkle!" exclaimed two or three. "Oh, to be sure, that's Rip Van Winkle yonder, leaning against the tree."

Rip looked, and beheld a precise counterpart of himself as he went up the mountain—apparently as lazy, and certainly as ragged. The poor fellow was now completely confounded. He doubted his own identity, and whether he was himself or another man. In the midst of his bewilderment the self-important man demanded who he was, and what was his name.

"Goodness knows!" exclaimed he, at his wits' end. "I'm not myself—I'm somebody else—that's me yonder—no, that's somebody else got into my shoes. I was myself last night, but I fell asleep on the mountain, and they've changed my gun, and stolen my dog, and everything's changed, and I'm changed, and my friends are gone, and I can't tell what my name is or who I am!"

The bystanders now began to look at each other, nod, wink significantly, and tap their fingers against their foreheads. There was a whisper also about securing the gun, and keeping the old fellow from doing mischief, at the very suggestion of which the self-important man retired with some precipitation. At this critical moment a fresh, comely woman pressed through the throng to get a peep at the gray-bearded man. She had a chubby child in her arms, which, frightened at his looks, began to cry.

"Hush, Rip," cried she, "hush, you little dear; the old man won't hurt you."

The name of the child, the air of the mother, the tone of her voice, all awakened a train of recollections in his mind.

"What is your name, my good woman?" asked he.

"Judith Gardenier."

"And your father's name?"

"Ah, poor man, Rip Van Winkle was his name, but it's twenty years since he went away from home with his gun, and never has been heard of since. His dog came home without him; but whether he shot himself, or was carried away by the Indians, nobody can tell. I was then but a little girl."

Rip had but one question more to ask; but he put it with a faltering voice: "Where's your mother?"

"Oh, she died but a very short time since; she broke a blood-vessel in a fit of passion at a New England peddler."

There was a drop of comfort, at least, in this intelligence. The honest man could contain himself no longer. He caught his daughter and her child in his arms and kissed them again and again.

"I am your father!" cried he. "Young Rip Van Winkle once—old Rip Van Winkle now! Does nobody know poor Rip Van Winkle?"

All stood amazed, until an old woman, tottering out from among the crowd, put her hand to her brow, and, peering under it in his face for a moment, exclaimed: "Sure enough, it is Rip Van Winkle; it is himself! Welcome home again, old neighbor! Why, where have you been these twenty long years? We thought you dead."

Rip's story was soon told, for the whole twenty years had been to him but as one night. The neighbors stared when they heard it; some were seen to wink at each other, and put their tongues in their cheeks.

It was determined, however, to take the opinion of old Peter Vanderdonk on the matter, who was seen slowly advancing up the road. He was a descendant of the historian of that name, who wrote one of the earliest accounts of the province.

Peter was the most ancient inhabitant of the village, and well versed in all the wonderful events and traditions of the neighborhood. He recollected Rip at once, and corroborated his story in the most satisfactory manner. He assured the company that it was a fact, handed down from his ancestor the historian, that the Catskill Mountains had always been haunted by strange beings; that it was affirmed that the great Henry Hudson, the first discoverer of the river and country, kept a kind of vigil there every twenty years with his crew of the ship Half-moon, being permitted in this way to revisit the scenes of his enterprise, and keep a guardian eye upon the river and the great city called by his name; and that his father had once seen them in their old Dutch dresses playing at ninepins in a hollow of the mountain; and that he himself had heard, one summer afternoon, the sound of their balls, like distant thunder.

To make a long story short, the company broke up and returned to the more important concerns of the election. Rip's daughter took him home to live with her. She had a snug, well-furnished house, and a stout, cheery farmer for her husband, whom Rip recollected for one of the urchins that used to climb upon his back. As to Rip's son and heir, who was the image of himself, seen leaning against the tree, he was employed to work on the farm, but before long there were signs of a hereditary disposition to attend to anything else but his business.

Rip now resumed his old walks and habits. He soon found many of his former cronies, though all rather the worse for the wear and tear of time, and preferred making friends among the rising generation, with whom he soon grew into great favor.

Having nothing to do at home, and being arrived at that happy age when a man can be idle with impunity, he took his place once more on the bench at the inn door, and was reverenced as one of the patriarchs of the village.

He used to tell his story to every stranger that arrived at Mr. Doolittle's hotel. He was observed, at first, to vary on some points every time he told it, which was, doubtless, owing to his having so recently awaked. It at last settled down precisely to the tale I have related, and not a man, woman or child in the neighborhood but knew it by heart. Some always pretended to doubt the reality of it. The old Dutch inhabitants, however, gave it full credit. To this day they never hear a thunderstorm of a summer afternoon but they say Hendrick Hudson and his crew are at their game.

THE NEXT STORIES ARE ON PAGE 4540.

Ollivier, Paris

Does a Hen Know that Chickens Will Come Out of Her Eggs?

ONE of the greatest of facts in the animal world is what is called instinct. One of the most important points about an instinct is that the animal goes through the action without knowing what its purpose is, or what will come of it. If an animal could foresee the consequences of its acts, then it would be a reasoning and intelligent being.

This is true of all instincts, that the action is done because something within the creature impels it to perform that action, but with no knowledge of its use and purpose.

Many of the higher animals, as you know, have some reasoning powers, or at least some memory. A dog may notice, after a number of times, that certain consequences follow upon its instinctive actions, and so it may get to know what will happen, just as we do after a time when we exercise our instincts.

It is unlikely that the hen, whether the first time or the twentieth time that she sits, has any idea except simply that things like eggs are very good to sit on. This is true, even though she is glad to see the fluffy little chickens when they come out of the shells.

IS THE WHITE OF THE EGG PART OF THE CHICKEN?

The white of the egg, and nearly the whole of the yolk, too, are not part of the chicken, but food for the developing chick. If we look at an egg that has just begun to develop, we can see on the surface of the yolk the little thing that will be the chicken; and a day or two later we can see tiny little blood vessels spreading out from this point over the yolk to help themselves to the food in the yolk. Afterward the white of the egg is also eaten up. The white of an egg consists of albumen and water. Albumen means the *white* thing.

This egg albumen is not the same as the

albumin in our blood on which our bodies feed, but it is very similar. When it is eaten by the developing chicken, or when we eat the egg, this egg albumen is changed by digestion into the blood albumin of the chicken or of ourselves, as the case may be.

WHY DOES BOILING MAKE AN EGG HARD?

Most solid materials melt when they are made hot enough. The melting point varies, as you know, for different substances. But there are certain kinds of chemical compounds with a name that means "like glue," and when these things are heated to a certain point, they turn firm, or stiff. They have very big molecules, each made of a large number of atoms. One of the best examples of them is white of egg, albumen. When an egg is heated to the temperature of boiling water, all the albumen of the egg turns solid. It coagulates. The same thing would happen to the albumin of blood.

WHY DOES A BAD EGG FLOAT AND A GOOD EGG SINK?

A good egg is heavier than water, so it must sink in water. In an egg that has become rotten the yolk and white have split up into other things, including gases. The gases escape from the shell, through the tiny pores that you can see if you examine an egg closely. The escape of gases makes the egg much lighter. Such an egg does not weigh as much as an equal bulk of water does. If placed in water it will not sink.

WHY CAN NOT WE BREAK AN EGG IF WE HOLD IT LENGTHWISE?

It is not exactly true that we can not break an egg held lengthwise, but certainly it is much more difficult to break the shell when we apply pressure to it at the two ends.

We may think of eggshells as made up of arches. Now, when an arch is narrow, it is much stronger, other things being the same, than if it is very wide and flat. The higher and narrower an arch is, the more directly does it resist any pressure from above. A very narrow arch is almost like an upright pillar. On the other hand, if the legs of the arch are wide apart it does not resist so well and may break under even comparatively little pressure from above.

Now, we may look upon the egg, when we press it from side to side, as made of two wide, and therefore weak, arches that resist us little. But when we press the ends, we are met by narrower arches that resist us so well that it is difficult to break an egg that way by hand.

WHY IS A SILVER SPOON BLACKENED BY EGG?

A silver or silver-plated egg spoon is blackened by the egg because the sulfur in the proteins of the egg combines with the silver of the spoon to form silver sulfide, which is a black substance. The sulfur in the egg, when the egg gets stale and begins to decompose, combines with the hydrogen in the egg, and so forms hydrogen sulfide. This gas gives to bad eggs their offensive odor.

HOW CAN A DUCKLING SWIM WITHOUT BEING TAUGHT?

The answer is: mostly by instinct, though there is perhaps a sort of teaching. At least, the duckling sees its mother launch herself upon the water and paddle away from shore. The duckling gets confidence from its mother, just as the young robin gets confidence from its mother and leaves the nest for its first timid flight.

WHY DOES A DUCK KEEP DRY IN THE WATER?

There is a structure, called a gland, that has an opening on the back of the duck near the tail. The business of this gland is to make oil, and the oil covers the feathers, making them extremely smooth and slippery. Oil and water will not mix, and so the duck, or any other water bird, having its feathers covered with a thick layer of this oil, keeps dry in water. The skin of a duck also seems more oily than that of a chicken.

THE NEXT WONDER QUESTIONS ARE ON PAGE 4593.

The duck's feathers are slippery and water does not soak into them.

OUR DOMESTIC POULTRY

F. S. A. photo by Delano
Barred Plymouth Rocks, general-purpose fowls.

IT is believed that the ancestors of our domestic fowls were the so-called jungle fowls of Asia. There are four or five of these —the red and the gray jungle fowls of India, the jungle fowl of Ceylon, the fork-tailed fowl of Java and the East Indies, and the Malay jungle fowls. Some naturalists think that all our domestic poultry has come from the red jungle fowl of India. Others think that more than one species was tamed, and point to qualities in our poultry not belonging to the red jungle fowl.

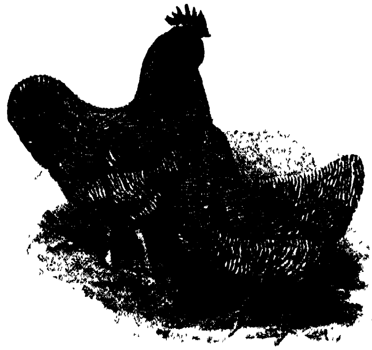
The Chinese say that they had hens more than three thousand years ago. The Greeks had them, and they were introduced into western Europe by the Romans. The early settlers of America brought some of them to this continent. Later, when American ships began to visit foreign ports, the officers brought back specimens of any fowls that struck their fancy.

By selection and crossing, man has made, and is still making, many changes in the shape, size, color and habits of fowls. A hundred years ago, hardly a dozen varieties were known. Now more than a hundred are recognized, and new "breeds" are added every few years. For example, the well-known barred Plymouth Rock was made by crossing other breeds and selecting the specimens that showed the desired qualities. Now we have not only the barred, but also white, buff, and other varities of Plymouth Rocks that breed true in shape, size and color.

In a state of nature a jungle fowl lays a batch of eggs—a dozen or less—hatches them, rears her brood, and may consider her duty done for the year. Occasionally she may lay a second batch. The habits of our domestic fowls are quite different. Where man wanted eggs more than chickens, he selected the best layers, generation after generation, and allowed only eggs from good layers to hatch. Now we have hens that have been known to lay over three hundred eggs a year and that do not attempt to hatch their own eggs at all.

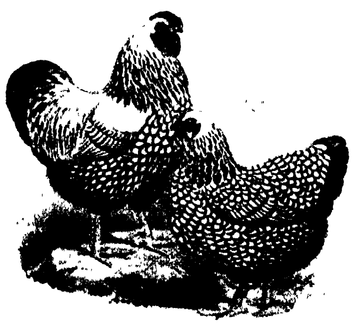
Where meat was more important than eggs, the poultryman selected fowl of large size that grew rapidly, and bred from them for

SOME POPULAR BREEDS OF FOWLS



BARRED PLYMOUTH ROCKS

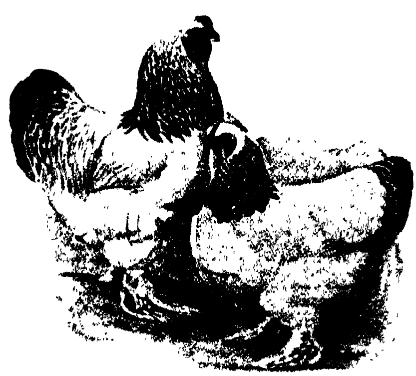
WHITE LEGHORNS



SILVER-LACED WYANDOTTES

BLACK MINORCAS

RHODE ISLAND REDS



LIGHT BRAHMAS

Plymouth Rocks, Wyandottes and Rhode Island Reds are called American breeds. They are general-purpose fowls because they lay well and yet are large enough for market purposes. The smaller Leghorns and Minorcas are Mediterranean breeds and are famous layers. The Brahmas are of immense size. There are several colors of nearly every breed of these fowls.

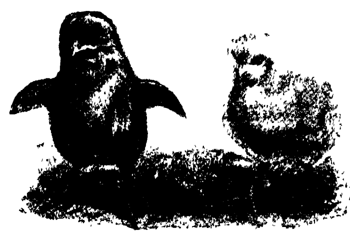
Pictures by courtesy of Pratt Food Company.

USEFUL AND ORNAMENTAL POULTRY

PARTRIDGE COCHINS

LADY EGLANTINE

BUFF ORPINGTONS



BABY CHICKS

HOUDANS

A FARMYARD SCENE

Partridge Cochins are heavy and handsome but do not lay many eggs. Orpingtons are an English breed, and appear in several colors. Houdans are chiefly bred in France. Lady Eglantine is a white Leghorn hen which laid 314 eggs in one year, the world's record at the time. There are over a hundred breeds.

Baby Chicks by courtesy of Kerr Chickery, Lady Eglantine by courtesy of Eglantine Farm; other pictures by courtesy of Pratt Food Company.

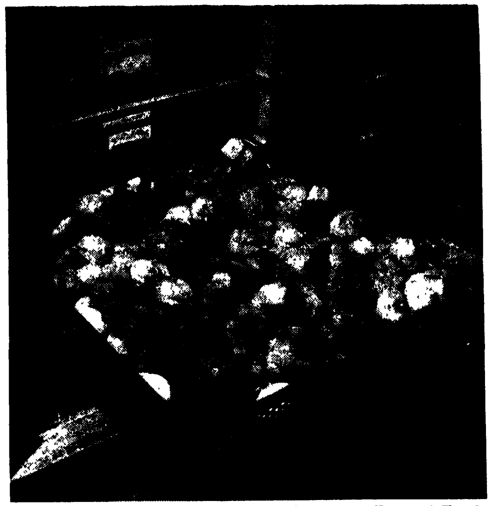
generations, until he had a fine strain of meat fowls. He has been able to do it with certainty by following the principles of heredity discovered by Gregor Johann Mendel, who showed how a particular quality in a cross could be fixed or bred out.

Our fowls of today may be broadly divided into two classes—useful and fancy. The first contains those breeds and varieties that are valuable for flesh or eggs, or both, and the other those valued chiefly for beauty or oddity.

The useful fowls may be divided into seven great divisions that include many breeds and varieties. These are: Mediterranean, Asiatic, English, French, American, Continental and Indian. All have strong advocates who think that the breed they like is the best.

The Mediterranean breeds are the great layers. They are rather small, and have almost lost the desire to sit and hatch their eggs. The best-known of these breeds is the Leghorn, of which there are something like eight varieties, distinguished principally by color and combs. They lay many large white eggs and are very active. They are too small to be of much value as market poultry, but when there is more profit in eggs you will be sure to find the Leghorns, white, buff, brown or black.

Other Mediterranean breeds are: the Minorcas, black and white, which are somewhat larger, the Spanish, the Andalusians and the Anconas. All lay well. Their eggs are large and white and in some markets bring a higher price than the brown eggs laid by the Asiatics and the Americans. In other markets brown eggs bring more. There is no reason for such distinction. The color of



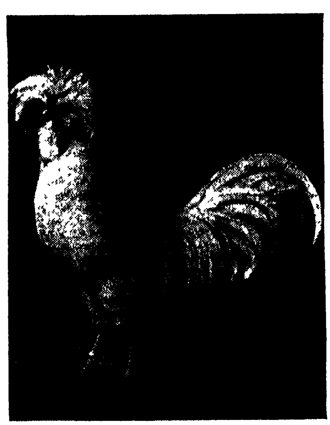
Birds Eye Frosted Foods

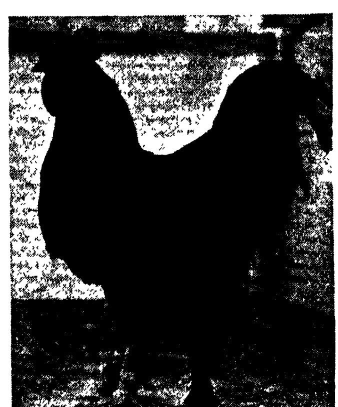
Balls of fluff—chicks just out of the incubator.

the shell has nothing to do with the richness or the flavor of the egg, which do depend somewhat upon the food eaten by the hens.

The Asiatics were brought from the East during the nineteenth century by trading ships. All are large and have feathers on their legs. They do not lay so many eggs as the Mediterranean breeds and are not so active. The recognized breeds are: the Brahmas, light and dark; the Cochins, buff, partridge, white and black; and the Langshans, white and black. Some of these weigh more than a small turkey.

The Asiatics have good dispositions and are not easily excited. They can be kept in a small yard without building a high fence





Cocks—left and right, a buff Cochin and a black Langshan, Asiatic breeds; center, a French white Houdan.

around it, as they have almost lost the power of flight. The Langshans are rather more active than either the Cochins or the Brahmas. The feathers on the legs of all the Asiatics are a disadvantage in a wet climate.

The English breeds are: the Dorking, Redcap Sussex, Cornish and Orpington. The Dorking is an excellent table fowl, and the Orpington is a large fowl with smooth legs that has been developed from the Asiatics. The French fowls have been carefully bred, and some of the best table poultry in the world is produced in France. The best-known breeds are: the Houdan, the Crevecoeur, La Fleche and Faverolle. The Orpington is the only one of these British or French fowls much bred in Canada or the United States.

Very early in America two distinct breeds became common, though it is not absolutely certain where they originated. They were the Java and the Dominique. These were bred together, and perhaps some other blood was introduced. At any rate, the barred Plymouth Rock appeared, and, as said above, there are now several other colors. They are what is known as general-purpose fowls. They are between the Mediterranean and the Asiatics in size, in the production of eggs and in activity. Another American breed, of which almost the same sort of things may be said, is the silver-laced Wyandotte, which also originated by crossing and selection. There are now several colors in the Wyandotte.

Years ago there were to be seen on many farms in Rhode Island some attractive chickens of reddish color. Probably the early sea captains had brought their ancestors from the Far East. From these the Rhode Island Reds developed. They are of medium size, good layers and active. Another breed developed from the same stock is the Buckeye. The Jersey Black Giants are another American breed. The New Hampshire strain is important, and from this has been developed the "Spizzerinktum," specially bred to supply the demand for broilers.

The best-known of the Continental breeds is the Hamburg, of which several varieties were developed in Holland. The Campine comes from the district of that name in Belgium. It is an excellent layer. The Indian, or Malay, is often classed with the games, but this is an error. It has been known in Europe for over a hundred years.

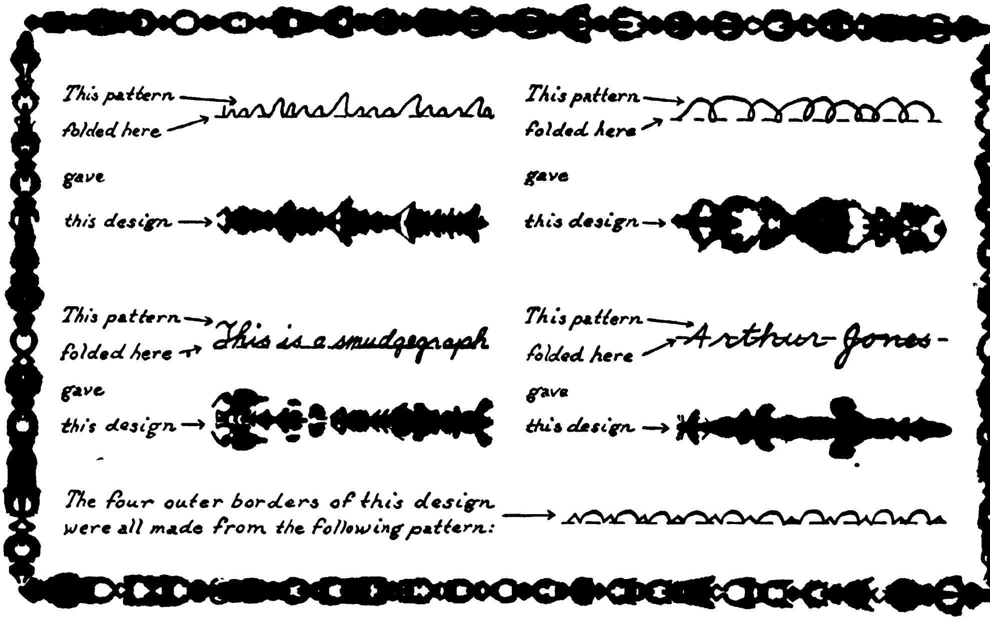
The fancy fowls include many breeds and varieties. There are: the Polish (though it did not come from Poland), with its crested head; the Silkies, on which the feathers resemble hair; the Frizzled, on which each feather curls away from the body. There are eight or more varieties of games. Their breeders claim that they should be classed among the useful fowls, but their savage dispositions are against them. There are many bantams, sprightly and attractive.

Some of these bantams are distinct breeds and are quite unlike most other breeds of fowls. Others are simply dwarf varieties of the larger breeds that have been made by crossing and selection.

THE NEXT STORY OF ANIMAL LIFE IS ON PAGE 4655.

U. S. D. A. Extension Service

White Leghorn chicks in a brooder house, where they are kept warm and clean, and fed from tiny troughs.



HOW TO MAKE SMUDGEGRAPHS

THERE is probably not one of you who at some time or other has not made a blot and ruined a neat examination paper or a theme or a pen-and-ink drawing. In this article, however, we are going to show you how to blot your designs deliberately. The results will often be very ornamental. A design produced in this fashion is called a smudgegraph; this word means a picture or design produced by means of deliberate blots.

No elaborate equipment is required to make the effective designs that we are going to show you. You need only paper, pen, ink and your thumbnail—certainly not an elaborate outfit for an artist!

First of all, rule a line very faintly with pencil on the paper that you are going to use. Then dip your pen in the ink and run a fairly thick zigzag line along the penciled line that you have just made. Before the ink becomes dry, fold the paper over at the bottom of the zigzag line, so that the inked side of the paper is pressed against the adjoining side. Next, press the paper firmly right over the fold with your thumbnail. When you open the paper again, you will find a symmetrical design: one in which the two halves of the pattern correspond to each other.

At first you will want to practice with lines that will be drawn at random along the penciled line. You may even make a series of deliberate blots and smudges along this line, and when you fold the paper over and press it, you will be astonished at the effective designs that you have created. Later, you will find it interesting to make definite designs along the penciled lines. These designs of course may be chosen from an infinite variety of patterns (note the one that was used to make the borders of the above design). The more lightly you press on the paper, the more faithful the completed design will be to the original pattern. The more ink you use and the harder you press, the greater the deviation will be from the original.

If you wish, you may write names or words along the penciled line, and the paper may be folded just at the base of the letters, or else the paper may be folded through the middle of the word, instead of along the bottom of it. If you wish, you may fold the paper first and write over the fold.

You will be amazed at the transformations that your patterns will undergo. Other ideas for producing smudgegraphs will occur to you as you proceed with the work.

A CHEMICAL WEATHER-GLASS

WE may have seen a curious-looking weather-glass in the form of a round tube containing a liquid which becomes clear or cloudy, or flaky or spotted, so that we can tell what sort of weather we are going to have. A good weather-glass is very easy to make. First we require a glass tube 10 inches long and $\frac{3}{4}$ inch across; we can purchase it at any drugstore. We fasten this tube to a flat piece of wood which is attached to the wall.

Now we must have a prescription made up at the druggist's. Here it is:

Camphor, 2 drams.
Potassium nitrate, $\frac{1}{2}$ dram.
Ammonium chlorid, $\frac{1}{2}$ dram.
Absolute alcohol, 2 ounces.
Water, 2 ounces.

If the solid ingredients do not dissolve readily, you may hasten the process by shaking the bottle or even putting it in a little warm water, taking care, however, that more water is not allowed to get into the bottle. When the mixture is properly dissolved, it should be poured into our glass tube.

Then we put a cork in the top of the tube, to keep out dust. The weather-glass is now ready for its work and may be hung up or placed wherever we wish to have it. It is best placed, however, exposed to the north and in a shady place, where it cannot get the direct rays of the sun. The appearance of the liquid will change when the weather is going to change. Here are the indications:

Clear liquid—Bright weather.

Crystals at bottom—Thick air, frost in winter.

Dim liquid—Rain.

Dim liquid with small stars—Thunder.

Large flakes—Heavy air, overcast sky, snow in winter.

Threads in upper part—Windy weather.

Small dots—Damp weather, fog.

Rising flakes which remain high—Wind in upper air.

Small stars in winter on bright, clear, sunny days—Snow in a day or two.

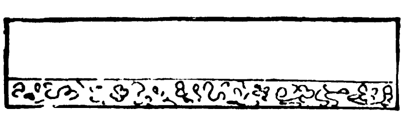
It would be well to write out all these indications on a neat card and to fix this by means of a thumb-tack to the piece of wood on which the weather-glass is mounted. Anyone examining the weather-glass will then have the key to the meaning of the different appearances.

A BONNET FOR A BABY DOLL

IF you have a baby doll, here is a pretty little bonnet made of a straight piece of material, as shown in picture 1. It is gathered on one side about $\frac{1}{4}$ inch from the edge as shown in picture 2, leaving a straight piece on each side. When the thread is drawn quite tight, just as it has been drawn in picture 2, draw together the two little straight pieces which you have left on each side of the gathers, and you will have the little round shape shown in picture 3. This represents the back of our bonnet, before trimming is added.

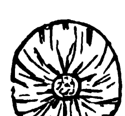
On each point of the front a ribbon is sewn to fasten the bonnet under the chin. To trim the little bonnet, put a flat piece of lace over the front edge of the bonnet, as shown in picture 1, while a tiny frilling of lace sewn inside all around will give a soft finish to suit the dimpled face of your doll. Make your stitches very close together so that they will not show.

A round piece of cardboard, about the size of a fifty-cent piece, should be covered with the material and adorned with lace or feather-stitching to cover up the gathered circle at the back of your bonnet.



1. The pattern of the bonnet.

2. The material gathered.



3. The back of the bonnet.

4. The finished bonnet.

The two little bunches of ribbon which are fastened to the top of the hat are not so easy to make as they appear at first. There is a right way and a wrong way to make a ribbon bow. The right way is to

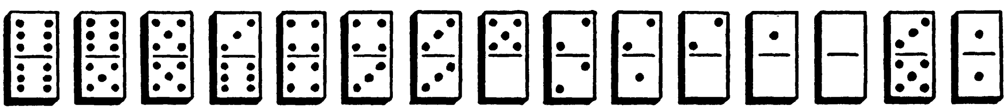
tie a little loop with strong thread (a long thread is required), bringing another loop by the side of the first one, then a third and a fourth. We must always twist the same thread round and round the ribbon without using a needle until the rosette is formed, and is big enough to put on the bonnet. The rosette is secured to the bonnet with a couple of strong stitches.

Some milliners first make and trim their hats in muslin, which can be cut, sewn, done and undone until the shape is perfect. This is the way in which you should first try to make this little bonnet. Try it in muslin or crepe paper, which is soft and elastic, and lends itself to this sort of work. In making a model out of crepe paper, we need not be afraid of spoiling good material.

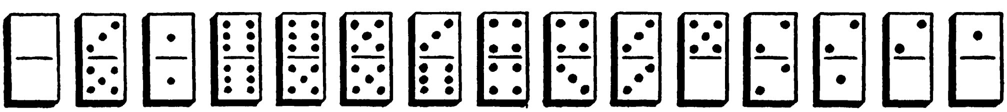
TRICKS WITH A SET OF DOMINOES

MOST of us possess a box of dominoes, but few of us probably ever thought of performing tricks of magic with them. As a matter of fact, however, one may perform a number of tricks with dominoes that will completely mystify the audience.

To begin with, we invite someone to pick out any domino he pleases, and, after noticing its spots, to hold it hidden in his hand. He is then to multiply the spots at either end of the domino by 2, add 5 to the product, multiply the total so obtained by 5 and add the spots at the opposite end. When he states the final result, we shall tell him just what domino he chose.



1. First position of the dominoes.



2. Second position of the dominoes.

To bring about this startling result, all that we have to do is to subtract 25 from the number given. The remainder will consist of two figures. One of these figures will represent the number at one end of the domino, the other figure the number at the other end of the domino. To make this perfectly clear to our young readers, let us choose a definite example. Suppose that the spots were 6 and 3. Twice 6 are 12; 12 and 5 are 17; 5 times 17 are 85. The addition of the 3 spots at the other end of the domino brings the total up to 88. This, therefore, is the number that is told to the performer of the trick. Subtracting 25 from 88, the remainder is 63, the two digits (6 and 3) supplying the desired answer. Whichever end of the domino we begin with, it comes to the same thing. Suppose we begin with the 3 instead of the 6. Twice 3 are 6; 6 and 5 are 11; 5 times 11 are 55; 55 and 6 make 61. Twenty-five subtracted from 61 leaves 36, again giving the spots of the domino, but this time in the reverse order, that is, 3 and 6.

After repeating the trick once or twice, we proceed to a feat of a different kind. We lay fifteen of the dominoes in a row face downward on the table. We take them in what seems to be haphazard fashion, but we really choose particular numbers. The first domino, at the left-hand end of the row, must be the double 6; the next a 6-5; the third either a 6-4 or a double 5 (either of these making a total of 10); the fourth a 6-3 or 5-4 (to make a total of 9); the fifth any domino that will show a total of 8; and so on with dominoes making a total of 7, 6, 5, 4, 3, 2 and 1 respectively. The thirteenth domino must be the double blank, after which we complete the row with any two other dominoes we please. The fact that the dominoes have been placed in this particular order is not known of course to the members of our audience, and we must be very careful not to let them see us choosing the numbers.

We now invite anybody in the audience to shift any number of the dominoes from the right-hand to the left-hand end of the row. We leave the room before he does so. Upon our return we say: "I know how many dominoes you have moved. In fact, I am going to pick up the very domino that will give me the correct answer." We then proceed to turn up a domino, and the total number of its points agrees exactly with the number of dominoes that our friend has shifted.

The secret lies in the fact that the third domino from the right-hand end of the row will always be the same as the number moved. Let us take an example. Let us say that the dominoes will first of all have the position shown in Figure 1, except that they will all be face downward. Suppose that three are shifted. The dominoes in the row would then have the position shown in Figure 2. We can see that the third from the right is the 2-1, representing the total 3.

For our third trick we challenge anyone to arrange all the dominoes in the accepted domino fashion so that they will form a ring. That is, we will put a 6 against a 6, 5 against 5, 4 against 4 and so on. We show that it can be done quite easily.

"It looks easy, doesn't it?" we remark. "But I am going to put a spell on the dominoes and while this lasts, nobody but myself can arrange the dominoes like this." We now mix up the dominoes. Nobody can now arrange them as we did before. You see, in shuffling the dominoes, we secretly took away any two of them *all four ends of which are different*. The rest of the dominoes can no longer be arranged in a continuous row.

We wave our hands over the dominoes and secretly put back one of those we had taken away. "Now," we say, "I will remove the charm and you will be able to arrange the dominoes in a continuous row, but not in a ring. I will leave the room. When you finish, cover the dominoes with a handkerchief and I will tell you the number at each end of the row." And we do so!

Here again the solution is simple enough. The domino that we are holding out would be necessary to complete the ring. For example, if your row ends in a 2 and a 1, a domino having the markings 2 and 1 would complete the ring. This missing domino, of course, is the one that we are secretly holding. We have a chance to look at the numbers on it when we leave the room.

FIELD HOCKEY

WHEN we speak of hockey nowadays we are apt to think of ice hockey, which we describe in another chapter. The earliest form of hockey, however, was not played on the ice, but on dry land—on a grassy field or a hard, sandy beach. This kind of hockey, which we call field hockey, goes back as far, at least, as the days of the ancient Romans. Formerly field hockey was considered to be a man's game. Nowadays it has come to be one of the favorite sports for girls. It is a vigorous game and one that teaches team work and good sportsmanship.

The game is played on a rectangular field, 100 yards long by 60 yards wide. Younger players use a somewhat smaller field; the minimum dimensions are 85 yards by 45 yards. We give a diagram of the field-hockey playing field on the next page; it will make clear the layout of the goal lines, 25-yard lines, center line, striking circles, side lines and 5-yard lines.

The goal consists of two posts, 4 yards apart, joined together by a horizontal crossbar, 7 feet from the ground. There are two other posts, from 4 to 6 feet back of the goal posts; they also are joined by a horizontal crossbar. Netting is put in place over all the posts and crossbars in such a way that only the space between the two goal posts is left entirely clear.

In field hockey the players hit the ball with a wooden stick, with a rounded blade. It has a flat surface on its left side only. Nowadays most players use a comparatively light stick, weighing from 18 to 20 ounces. The ball used in the game has a circumference of about 9 inches; it must weigh not more than 5¾ ounces and not less than 5½ ounces. It has a white leather cover; the inner part is made up of cork and twine.

Each team has eleven players; five forwards, three halfbacks, two backs and a goalkeeper. The forwards must be swift runners, able to dodge and to shoot well and also to get the ball away quickly after taking a pass from a team mate. The halfbacks must help the attack by feeding the ball to their forwards. The backs must be able to hit the ball hard and straight and to stop hard-hit balls.

The goalkeeper is the last line of defense. Her duty is to prevent the ball from passing between the posts and to clear—that is, to send it away from the neighborhood of the goal. The goalkeeper protects her legs by wide pads that extend from the ankle to slightly above the knee.

Each team tries to put the ball through its opponent's goal as often as possible and at the same time to prevent the opponent from scoring. In college field hockey the playing time is 60 minutes. There are two halves of 30 minutes each; generally there is an intermission of five minutes between halves. In the case of high-school and junior players the length of the halves is shortened to 25, 20 or 15 minutes, according to the agreement made before the game. After each half the two teams change goals.

THE GAME IS STARTED BY TAKING A BULLY FROM THE CENTER LINE

The game is started by two players, one from each team, *bullying* in the middle of the center line. These two players stand opposite each other, facing the sidelines. The other players must stand at least 5 yards away and must be between the center line and their own goal. In *taking a bully,* each of the players first strikes the ground on her own side of the ball and then her opponent's stick over the ball. This is done three times. After that, either player may hit the ball at will, thus putting it into play. Bullies at the center line are taken not only at the beginning of the game, but also at the beginning of the second half and after a goal has been scored by one of the teams.

When a player hits the ball over the side line, it must be rolled (not thrown) into the field again by one of the opposite side. This player must stand at the point where the ball crossed the side line. With her stick and both feet outside the line, she must roll the ball in any direction along the ground. All the other players must stand at least 5 yards from the side line in question. The moment the ball leaves the roller's hand, it is in play. If the ball went out of bounds off the sticks of two opponents, a bully is taken on the 5-yard line (see the diagram) directly opposite the place where the ball left the playing field.

If the ball is sent over the goal line, not between the goal posts, by a player of the attacking team, a bully is taken on the 25-yard line, at a spot opposite the place where the ball crossed the goal line. A bully is also taken on the 25-yard line if a defender, standing beyond her 25-yard line, unintentionally sends the ball over her own goal line but not between the goal posts.

A goal is scored (1) when the ball passes between the goal posts and under the crossbar after being hit by the stick of an attacker inside the striking circle; (2) when a ball struck by an attacker within the striking circle touches a defender before going between the goal posts. A goal counts as

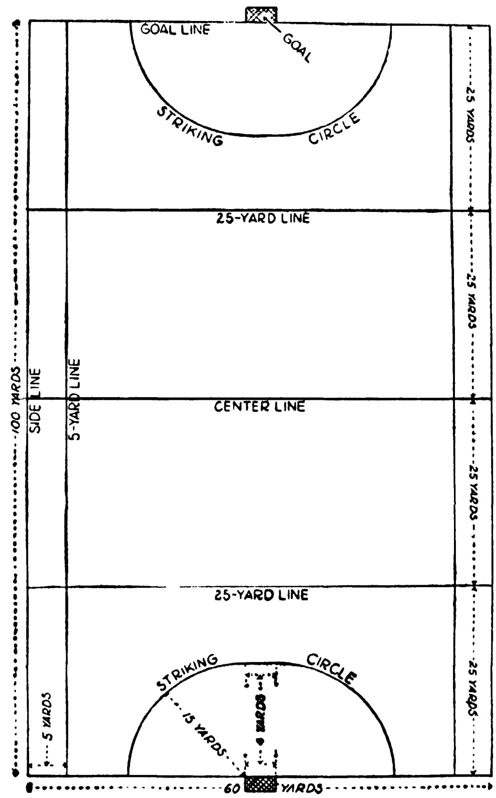


Diagram showing field-hockey playing field.

one point. If the score is tied at the end of the game, the game remains drawn.

Here are the rules about fouls. A foul is declared when a player raises any part of the stick above the shoulder while striking the ball; touches the ball with the back of the stick; fences or hooks sticks with any opponent who is not within striking distance of the ball; strikes, charges, collars or trips an opponent; gets in the way of an opponent who is running after the ball; picks up, carries or kicks the ball. (A goalkeeper, however, is permitted to kick

the ball if she remains within her own striking circle while doing so.)

A number of penalties are provided. If a foul is committed by either side outside the striking circles, a *free hit* is given on the spot where the foul occurred. A player of the team that was fouled is allowed to hit the ball in any direction. None of the offender's side are allowed within 5 yards of the ball. The player who takes the free hit must not play the ball again until it has been touched by another player.

If an attacking team fouls within its opponent's striking circle, the defending team has a free hit from any point within the circle. If a foul has been committed by the defending team within its striking circle, a *penalty corner* is given. One of the attacking team hits the ball from any part of the goal line, not less than 10 yards from the nearest goal post. No other player may stand within 5 yards of the ball. The members of the attacking team remain outside of the striking circle. Six members of the defending team stay behind their own goal line; the rest, beyond the 25-yard line.

If a particularly serious foul has been committed by the defending team within the striking circle, a *penalty bully* is awarded the attacking team. A bully is taken on a spot 5 yards in front of the center of the goal line. It is played by the player who fouled and a player selected by the other team. All the other players must keep beyond the nearer 25-yard line.

If, during a penalty bully, the ball strikes the stick or person of the defender and then goes over the goal line but not between the goal posts, the bully is taken over again. If the ball goes between the goal posts off the stick of the attacker or off the stick or person of the defender, a goal is awarded to the attacking team. If either player sends the ball outside the striking circle or over the goal line, not between the goal posts, the game is started again by an ordinary bully taken in the center of the nearer 25-yard line.

If the ball is unintentionally sent between the goal line by one of the defending team who is within the 25-yard line, the umpire gives a *long corner* to the other team. That is, a player of the attacking team has a free hit from a point on the side line or the goal line within 5 yards of the corner, on the side of the field where the ball went out. All other players stand as for a penalty corner. No goal can be scored from a long corner unless the ball has first been hit by another member of the attacking team, or unless it has hit the stick or person of one of the defending team. If the ball is deliberately hit behind the line by a defender within the striking circle, a penalty corner is given.

Generally two umpires are in charge of the game; each covers one-half of the field. If there is only one umpire, two linesmen are assigned to give decisions in cases where the ball passes over the side lines.

HOW TO MAKE YOUR OWN FIRE-SCREENS

FIRE-SCREENS can be made so that they are both serviceable and decorative in the household. The foundation framework is easily constructed by a boy or girl who has some skill in using tools and materials. The most useful screen is made in three panels, each 4½ feet high and 1½ feet wide. The frames are made preferably of thoroughly seasoned white pine, to avoid warping. They are usually mitered at the corners and braced in the middle.

The frames should be covered either with brown sheeting or with unbleached muslin, which is stretched as tight as possible. It is held in place by very small tacks, which are driven into the edges of the frames. After doing this, carefully cut away all the surplus material. Then prepare a sizing of thin flour paste, and with it wet thoroughly every portion of the muslin. In stretching, the cloth may pull unevenly and cause slight roughness of the surface. However, this can be smoothed down while wet and held in place by the paste when it dries. The drying takes only a short time.

In selecting the proper covering individual taste may be exercised. The beautiful varieties of wallpaper render it easy to make a good selection. If it is to be used in the nursery the little ones will be most interested in both bright colors and quaint figures. The background of the screen should ordinarily be of somewhat dark wallpaper of indefinite pattern. In cutting the paper for the front of a panel a margin of about 1½ inches should be allowed on all sides, while

the back piece should be the exact size of the frame. The paste should contain a little starch, but it must be free from lumps and not very thick. It needs to be applied as evenly as possible. Care is needed to see that every part of the paper is covered by it. Place the paper upon the frame, beginning at the top and allowing the surplus 1½-inch margin to lap over. Put a piece of wrapping-paper under the hand and slowly smooth the pasted part for about 6 inches down from the upper edge, thus pressing out all air bubbles and wrinkles. When this is successfully done, continue the same process, always smoothing downward.

Should any creases or other irregularities fail to disappear during the slow rubbing, take the paper by the two lower corners, lift it from the muslin until past the roughness, and then press again. In this way you are certain to remove any imperfections and to secure a perfectly plain surface. The margin is next to be pasted and will lap perhaps ¼ inch on the back. This will, however, be covered by the paper for the back of the panel, which is to be applied in the same way as the front piece.

The hardest part of the work is now over. Next secure an illustrated book of nursery rhymes or children's stories. Cut out every figure in the book, large and small alike. Select three of the largest and handsomest for the centre pieces, and about these arrange the others attractively without regard to the stories which they illustrate. If you wish, you may make designs with paper cut-outs, as explained on page 2739.

The back may be ornamented in a similar manner or else it may be left plain. Four brass hinges are needed to fasten the frame together. A line of brass-headed nails might well be added all around the edges, both to serve as a protection for the paper and as a finish. Finally two small brass handles placed on top of the outer panels, to avoid soiling by frequent handling of the screen, complete one of the most attractive and serviceable furniture decorations in the house.

THE GAME OF STICKERCHIEF

A SPLENDID game that can be played by any number of children is stickerchief. It is quite as exciting as hockey or tennis and it has the advantage of not requiring expensive balls, racquets or sticks.

Stickerchief is played with a handkerchief and some short pieces of bamboo, of the sort used by gardeners to hold up tall flowers. A dozen of these bamboos can be bought at any florist's for a small sum.

The game can be played on a lawn of any size. Two goals, one at each end of the lawn, are required and these will be formed by the flower-sticks stuck into the grass about four feet apart. When two sticks have been placed at each end of the lawn in this way you can begin.

It is best to make the first attempt with only two players. Each must have one of the light bamboo sticks, and they must stand in the centre of the lawn between the two goals. Now they must place a handkerchief on the ground, and stand on opposite sides of it with the ends of the sticks just touching the ground, about a foot away from the handkerchief.

Then one player must count "One—two—three—go!" and at the word "go" both must try to pick up the handkerchief on the sticks. This is much more difficult than it looks. Each player tries to knock his opponent's stick away.

Presently one manages to pick up the handkerchief, and then runs as fast as he can toward the opponent's goal. Of course, the other player follows, and tries to get the handkerchief off the stick. If he manages to get it on his own stick he rushes with it to the other goal.

Sometimes the handkerchief flies off the stick while the player is running with it, and then the other player can often catch it before it reaches the ground. Sometimes it is skillfully knocked off, and sometimes neatly lifted off. Any way is considered fair; the game is simply to get the handkerchief through the opponent's goal and to prevent him from scoring. A game is finished when a goal is scored. A match consists of five games, and the player who wins the most games is the victor.

After a little practice any number of children can play together. Two captains are chosen, and these captains pick the players who are to form the teams. Four, six or even ten players may be in each team; in fact, the only limit is the size of the lawn that you use as a playing field.

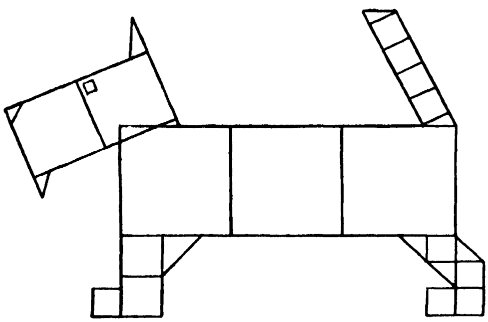
When all are ready, and have been provided with the sticks, the captains tell the

players where they are to stand—some close to the goal, and others near the middle of the lawn. Then the captains take their places by the handkerchief, and start the game at the word "go." Of course, the game becomes much more exciting when a number are playing, and often it is quite a long time before either side can score a goal.

If there are many players on each side, they ought to be distinguished in some way, so that they can be recognized at once as friends or foes. It is a good plan to tie little bows of ribbon in the middle of each stick. One side can have green bows and the other red. These are very easily seen.

The game is a splendid one for a children's party, as boys and girls can play together. It has all the fascination and excitement of hockey, without the danger of bruises that are too often caused by hard balls and heavy sticks. The light bamboos used for stickerchief cannot hurt anybody.

HOW TO MAKE A SCOTTIE



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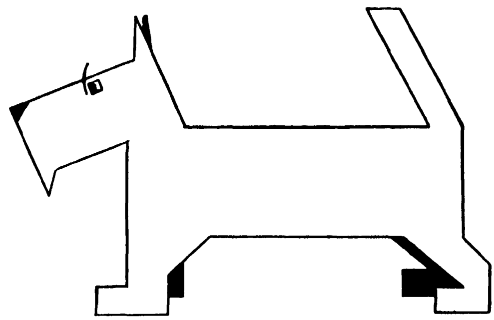


2

IT is quite easy to make a picture of a Scottie, that quaint little dog with the big head and the playful disposition. With a pencil you make a series of squares and triangles as shown in the first picture. When this part of your task has been completed, you are to erase all the lines except those that are to appear in the finished drawing, as shown in the second picture. You then add a few touches and your Scottie is ready.

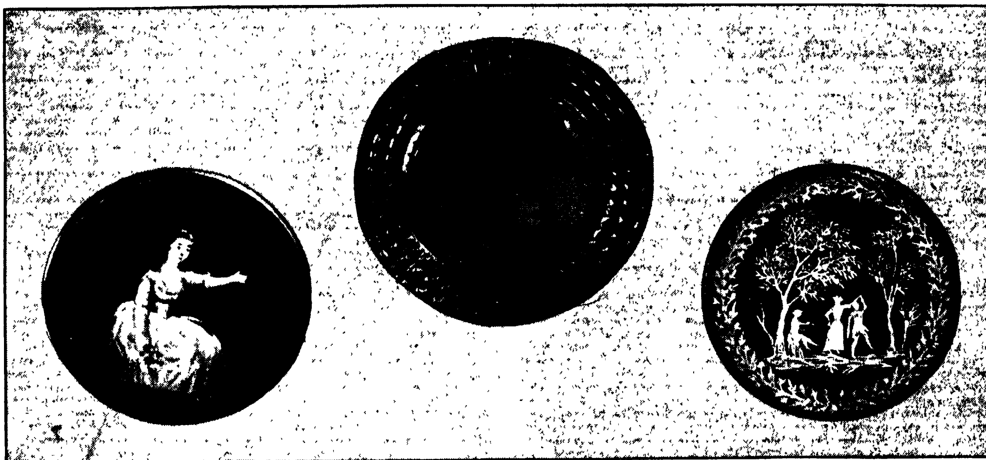
THE TRAVELER AND THE WOLVES

THE slowest runner of the boys who are to play this game is the traveler, and the traveler has to get to his journey's end without being caught. The rest of the players are the wolves. Before setting out on his journey the traveler is given as many balls as there are wolves. When he has got some distance away, the wolves shout that they are coming and the race begins.

When the traveler finds a wolf overtaking him, he calls his name and throws out one of the balls. The wolf whose name has been called must secure the ball before he can take up the race again. Of course the traveler's object is to throw the ball in a way that will lead the wolf from the direct path. He should never throw it in front, or the swifter runner will pass him to secure the ball and then merely wait for the traveler to come up. The traveler should do his best to find out where the nearest wolf is, and the more skill he shows in managing the balls, the greater will be his chance of escape. Above all, he should not throw the balls away too soon or he will be lost.

If the chances against him are very great at the start, he might be provided with more balls than there are wolves. Of course a distant spot should be chosen as a goal.

THE NEXT THINGS TO MAKE AND TO DO ARE ON PAGE 4617.



Courtesy, Cooper Union Museum

Old French buttons: the first is of painted porcelain in classic design; the second, a "freedom" button with the words Vive la liberté (Long live liberty); the third has a picture cut out of paper and pasted upon silk.

THE STORY OF BUTTONS

BUTTON-LIKE discs or knobs were used as ornaments as long ago as the Bronze Age. Such ornaments served to decorate belts and other leather objects. For thousands of years, however, it did not occur to people that they might use buttons to fasten their clothes. Primitive man used thorns and sinews for that purpose. Later, more civilized peoples, like the Egyptians, Greeks and Romans, fastened their clothes with tie strings, pins, brooches and buckles.

One fine day the discovery was made that the ornamental button might be made to serve as a very effective fastener. One could either push the button through a slit in a garment or slip a loop over it. Some say that the button was first used in this way in antiquity, though this is rather doubtful. It is hard to tell whether some of the buttons shown in pictures and sculpture of the Middle Ages were really fasteners or were merely ornamental. At any rate, it is fairly certain that by the thirteenth century A.D. buttons were used as fasteners.

By the sixteenth century buttons had been widely accepted as a part of one's everyday attire. They were sometimes used lavishly, too, in decoration. It is said, for example, that there were 13,600 gold buttons on a single costume of the French King Francis I, who lived from 1494 to 1547.

Two centuries later button-making had become a flourishing industry, particularly in France, Germany and England. Buttons were made of metal, jewels, cut stone, mother-of-pearl, leather, wood, cut steel, porcelain, glass and other materials besides. They were much more expensive than they are now. Shaping and decorating were done by skilled artisans, working on only one button at a time. Buttons were not discarded with one's old clothes. They were removed from the old garment and sewed to the new, and this process was repeated again and again.

The first buttons made in the United States were of metal. In 1750 Caspar Wistar, a German immigrant, began to manufacture brass buttons in Philadelphia; this conscientious man guaranteed his buttons for seven years! Within a few years several firms in New England were producing buttons. The output was still so small at the outbreak of the American Revolution (1775) that the metal buttons used on the uniforms of American soldiers had to be imported from France.

During the War of 1812, button imports were cut off as a result of the British blockade. Aaron Benedict, a button-maker of

Waterbury, Connecticut, made the most of the golden opportunity offered by the war. He bought every brass pot and pan on which he could lay his hand and rolled the metal for buttons in his own rolling mill. When he could no longer get brass, he made his buttons out of pewter. After the war the metal-button industry made rapid progress. Buttons covered with cloth were introduced, and then horn buttons, made from the horns and hoofs of cattle.

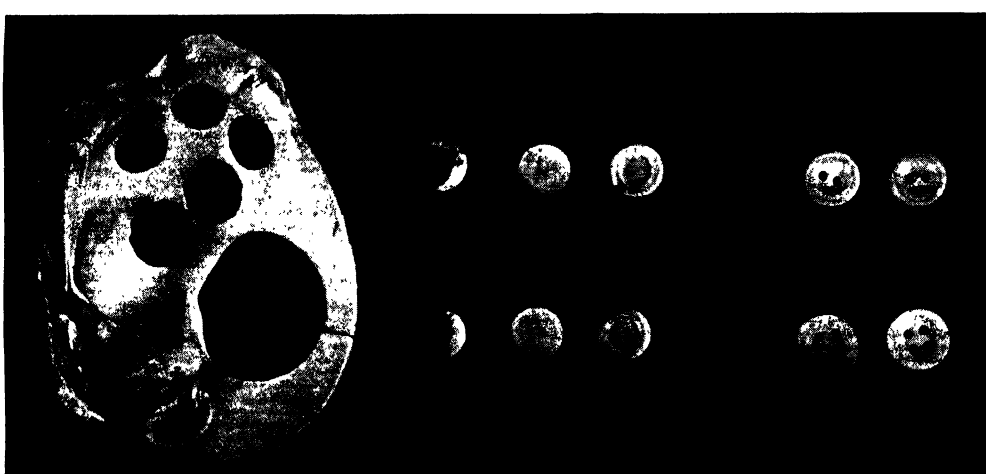
The vegetable-ivory button was invented in Austria in 1859; this was made from the corozo or tagua nut, the fruit of a palm tree.

After 1860 the pearl button began to come to the fore, and by 1900 it was the most popular button of all. The first pearl buttons were made of the pearl oyster's shell. These were known as ocean-pearl buttons because the pearl oyster is found in the ocean. Later the shells of fresh-water mussels were widely used. In our century, plastic buttons have come to the fore. The term plastic in the button industry means a synthetic material that can be molded into a desired shape. Plastics lend themselves excellently to mass production and there is a minimum of waste in the manufacture of buttons made from these materials. Today more buttons are produced from plastics than from any other material.

Plastic buttons are made in different ways according to the material used. Let us take the case of galalith (casein) a milk product widely used in button-making. The galalith is mixed with coloring matter and other ingredients. The mixture is then fed into a machine that operates like a meat-chopper. The mixture comes out of this machine in the form of plastic rods. Sometimes sheets are made from these rods by pressing in heated presses. Generally discs are sliced from the rods or punched from the sheets and are then hardened in formaldehyde. The discs are turned (that is, placed on a rotating lathe and brought in contact with a cutting tool). Then they are carved, drilled and polished.

Some plastics, like Bakelite and Plaskon, are made into buttons by the process known as compression molding. The plastic material is received by the manufacturer in the form of a dry powder. First, by means of rotary pill machines, like those used in making medicinal pills, the powder is converted into preforms or pellets (pills) of about the size of the finished button. The preforms are molded in large cavity dies. In a die containing 140 cavities, 140 buttons are produced by each closing of the die! After they have been molded, the buttons are tumbled about in a revolving barrel-like machine to remove excess material. Then they are filed, drilled and polished.

A process called injection molding is used to manufacture buttons from cellulose acetate plastics, such as Tenite. The plastic material is prepared in powder form. It is dumped into a hopper in the injection-molding machine and goes into a heating chamber



Courtesy, The Brooklyn Museum

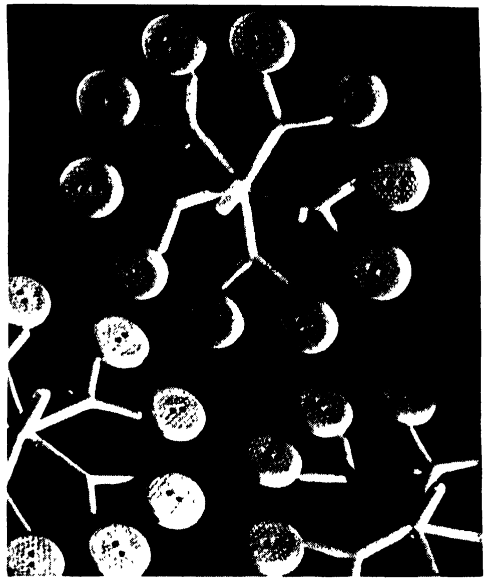
Pearl buttons, as we call them, are made from the pearly linings, nacre, of oyster and fresh-water mussel shells. A shell is soaked in water for several days to make it less brittle. Then a tube-shaped saw, whirling very rapidly, cuts thick blanks from the shell. These blanks are split to make buttons of the right thickness.

where it acquires the consistency of paste. Then a piston pushes it out of the heating chamber through a nozzle, and from the nozzle it is squirted into a mold. This has a number of cavities (sixteen or twenty-four, as a rule), each large enough to contain the material for one button. The cavities are connected with each other by means of little channels.

The plastic paste is squirted into the mold while it is warm and "runny." It flows along the little channels into the button cavities. The temperature of the mold is cold enough to cause the plastic material in the cavities and in the channels as well to harden almost instantly. When the contents of the mold are ejected from the machine we have a number of buttons connected by little stems—like buttons on a button tree!

The buttons are now broken from their stems by means of a buffing (cutting) machine, and the stems (or sprues, as they are called) are reground into powder form and used as material for other buttons. From 50,000 to 250,000 buttons can be made in a twenty-four-hour day from a single machine by the injection-molding method.

Celluloid buttons are manufactured in various ways. In the process known as frazing, blanks (that is, pieces of about the size of the finished button) are cut from large round rods. In some cases the blanks are placed in holders called chucks, and then turned. In other cases the button is held stationary in the holding chuck, while a revolving blade makes the design on the button. In making die-pressed celluloid buttons, round discs are cut from celluloid sheets and then pressed into shape by means of dies. Twisted celluloid buttons are made from thin rods softened in boiling water. The rods are twisted by hand into all sorts of striking shapes.



Courtesy, Tennessee Eastman Corporation

In injection molding, plastic paste is squirted into a mold that has spaces for several buttons. When the paste has hardened the buttons are cut apart.

LUSTROUS BUTTONS FROM THE BED OF THE SEA

Of the buttons made from non-plastic materials, pearl buttons are manufactured in the greatest numbers. Shells for the ocean pearl buttons are secured chiefly from the waters surrounding Australia and the East Indies. The shells are first soaked in water for several days in order to make them less brittle. They are next cut into blanks by tubular saws revolving at high speed. The blanks are now split crosswise two or three times, depending on the thickness desired for the finished button. The back of each blank is either ground flat or else is rounded under an emery wheel. After grinding, the blanks are placed in chucks on an automatic pattern machine. As each blank is carried around the machine it meets in succession tools that shape it into any desired pattern, round its edges and drill it with two or four holes. To give it its luster, the button is placed in a barrel of acid and then tumbled in a barrel of sawdust.

Fresh-water pearl buttons are manufactured like ocean-pearl buttons, except that the blanks are not split crosswise.

The vegetable-ivory nuts from which vegetable-ivory buttons are made are imported principally from Ecuador, Colombia and Panama. The nuts are first dried under intense heat; this causes the nut to shrink from the shell. Rolling in a metal drum then makes the shell break off.

The nuts are cut by means of circular saws into slabs which are dried in kilns until all moisture has been removed. Blanks are cut from the slabs, turned on lathes and then drilled. The buttons are given a solid color by being dyed in vats. To produce a mottled effect (one in which several colors blend into each other), different shades of color are sprayed upon the buttons through stencils. The final coloring is done by vat dipping. Sometimes the buttons are embossed. Vegetable-ivory buttons are used

chiefly on men's suits, army shirts and women's tailored clothing.

Metal buttons are of three kinds. There are uniform buttons for soldiers, sailors, policemen and the like; ornamental buttons for women's coats and dresses; staple buttons for work clothes.

Uniform buttons are of brass. They are made in two parts—the front, containing the design, and the back, containing the shank. Blanks for the front part are heated, cleaned and then stamped with the design; sometimes the process is repeated several times to make the design stand out more clearly. Finally gold plate is applied and the button is polished. The shank is attached to the back part of the button by soldering; the back is then plated with gilt and the front and back of the button are put together by means of a die.

Other brass buttons, made in a similar way, are sometimes used for ornaments on women's garments. Frequently fancy buttons are made of white metal. (White metal has a tin base and is alloyed with copper and antimony.) These buttons are manufactured by means of rubber molds. After being molded, the buttons are plated with copper, gold or silver, as desired.

Covered buttons are generally made by covering metal parts with the same materials as those from which the garment itself has been made.

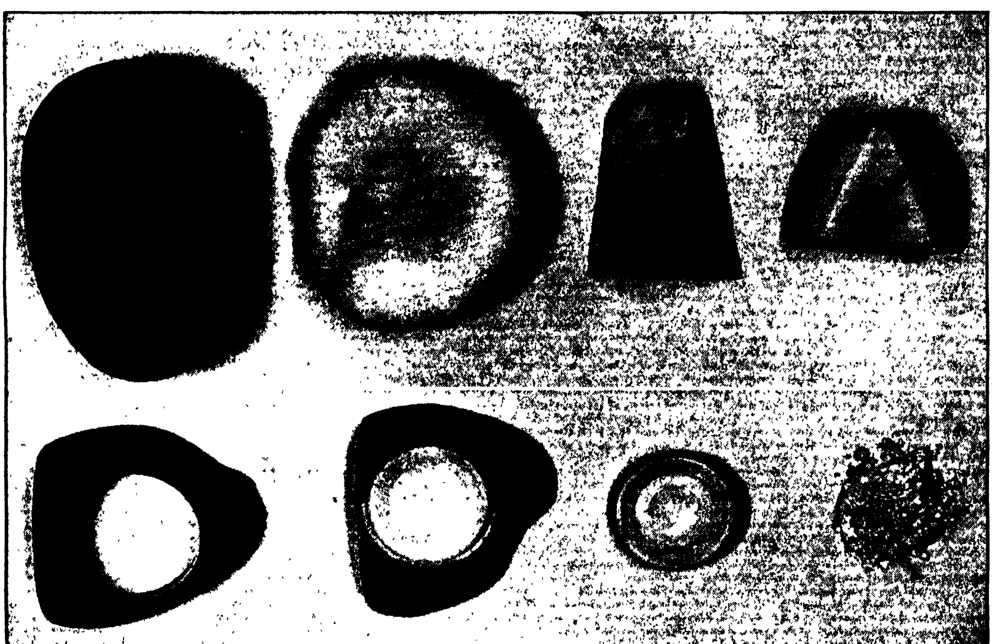
Horn buttons are now made chiefly from cows' hoofs, ground to a powder and mixed with color ingredients and a small quantity of water. No glue or other binding agency is added, as the hoof contains natural glue. The mixture is poured into dies containing about one hundred cavities. The dies are heated and then chilled. The buttons are removed from the dies, filed, drilled and polished.

Bone buttons, made from the shinbones of cattle, are generally used on undergarments or the inside flaps of garments, where buttons are not visible. The first manufacturing step is to soften the bones by soaking them overnight. They are then cut into slabs by circular saws. Automatic machines now cut the buttons from the slabs, turn them and drill them.

The unit of measurement for buttons is the line; there are 40 lines to the inch. Thus, when one speaks of a 30-line button, one means a button which is ¾ of an inch in diameter.

By Edward L. Newberger.

THE NEXT STORY OF FAMILIAR THINGS IS ON PAGE 4739.



Courtesy, The Eureka Button Company

How a vegetable-ivory button is cut from the corozo nut, the fruit of a palm tree.

© Ewing Galloway. **Snow-bent aspens straightening in springtime.**

AMERICAN TREES IN SUMMER

OUR continent is so vast that the plant life in one corner in no way resembles that of another. Speaking in general terms, each corner, or desert, or mountain range, or river-bottom, or sea-beach has its own variety of soil and climate and a plant population that has fitted itself for ages to withstand the trials of life in that particular locality, be it large or small.

These great divisions of plant life are called "floras," and so distinct are they, except where they mingle on the border-lands, that skilled botanists say that if they were taken blindfolded on a magic carpet to any part of North America, by looking around at the plants they could soon tell pretty nearly their whereabouts. If they should be dropped in a grove of the trees which we have pictured, for instance, they would be sure that they were in the eastern half of the continent, and they might guess that they were somewhere between the Great Lakes and the Atlantic Ocean.

Let us imagine that the botanist's carpet has descended in the scraggy branches of a sweet-gum tree; he would know that he was east of the Mississippi and probably south of the St. Lawrence, for the sweet-gum does not go much farther in that direction. On the other hand, if he found the lovely little striped maple, he would know that he must be north of Georgia, for this tree rarely travels farther south. The odorous bayberry would warn him that he was near the coast; and tree after tree would add its evidence to help him to locate himself.

In this way we have come to think of certain trees, or groups of trees, as always to be found in certain parts of America. When we speak of the southeastern coast, we promptly remember the tufted palmetto; while the persimmon and magnolia and the moss-draped live oak are always present in our dreams of the Mississippi bayous; and of course we never forget the white pines of Canada.

But Canadians always remember the maples, for these trees grow so abundantly in Canada that a maple leaf has been chosen as the emblem of the dominion. There are many varieties of maple. One of them that we frequently read about in hunters' tales is usually termed Moosewood, because, it is thought, the moose love to eat its great, tender buds that are close-wrapped in crimson scales. It is also called the Striped Maple. Although it

is rarely seen growing alone, it is readily recognized in the copses by its smooth green bark, striped with white, and by its great soft three-lobed leaves. It is almost a shrub when compared with the great Red Maple and the Sugar Maples. The former is one of the first trees to turn its coat and warn us of the coming of winter, showing vivid patches of red here and there very early in autumn. The sugar maple, on the contrary, is inclined to become golden or pale scarlet, and often its foliage is mottled with both colors. While the red maple adorns itself with tufted deep red blossoms before the leaves unfold, the sugar maple drops its tassels of honey-colored flowers beneath the newly opened foliage.

THE SUGAR MAPLE AND MAPLE-SUGAR

A well-grown field Sugar Maple is a magnificent tree, shaped something like a pyramid, with solid-looking dark foliage. Its leaves are very simply lobed with squarish divisions. Its pale-tinted wood is hard and very heavy, and, as we all know, is made into hardwood floors, furniture and the like. It is especially valuable when the tree grows so that the wood has the appearance that we call "bird's-eye maple." "Curled" maple, which we get from both the Red Maple and the Sugar Maple, is valuable also. But altogether the most interesting thing about the sugar maple is the syrup and sugar! It is a small Quebec or New England farm that has not a sugar-bush; and it is one of the pleasant duties of the farmer to go out in the snowy springtide, and by boring holes in the bark of the sugar maple and fixing little spouts therein, to draw off the sap that is rising upward just under the rough bark.

The sap in this stage is colorless, thin and faintly sweet to the taste. By careful boiling the water in the sap is evaporated, and in time the liquid becomes a syrup and finally turns to sugar. The sap-boiling is a time of gaiety for young folks, who frolic in the snow and about the huge bonfires under the sap-kettles and eat maple-sugar in every form they can invent.

The early settlers learned this art from the Indians in western Massachusetts, who made the sugar and sold it, dark brown and coarse and filled with bits of twigs and leaves, but nevertheless delicious, in little birch-bark boxes. Sometimes they took out the water from the sap by freezing it night after night, each morning throwing away the cake of ice that had formed and that contained most of the water, leaving the sugary thick fluid. They even ate scrapings of the sappy, sweetish bark, as the southern negroes chew sugar-cane. Some Indians have a curious habit of putting maple-sugar on their meat or in soup, instead of salt, which they do not like, as well as eating it as we do, on hominy or boiled wild rice.

THE HONEY-LOCUST—A HANDSOME TREE WITH FEATHERY FOLIAGE

Another sweetmeat for the Indian children was the pod of the Honey-locust. This is a handsome tree that has traveled far from its original home in the Middle West, and has spread widely its flattened top in many a park and highway. The leaves are composed of many small leaflets, among which the clusters of long flat black and twisted pods are easily seen, especially as they stick to the branches during the winter. They are filled with a sweetish watery pulp in which the hard seeds lie, and this is pleasant to the tongue. The honey-locust is distantly related to the acacias and mimosas about which travelers in African deserts tell us. We remember that they also speak of the vicious thorns that endeavor to protect the feathery foliage, but which the giraffe ignores when he reaches over the mimosa tops with his long neck.

Our locust, like them, is well armed with enormous spines, which are polished and branched, every spur being quite capable of stabbing to good effect. They appear in the most unlikely places on branches and trunk, often in groups. Unlike the common locust, the flowers are inconspicuous, but its trembling foliage, which scarcely casts a shadow, gives the tree a charming delicacy of outline. We may notice that the pale little leaflets rise up as the sun sets and press their upper surfaces together. This is called their "sleep," and prevents the escape of heat from the delicate leaves at night, and also reduces the chance of injury from excessive coolness, heavy rains, and so forth.

THE MAGNIFICENT COLUMN OF THE TULIP TREE

Some of our trees have leaves of so unusual a shape that if we once see them, we

TWO MONARCHS OF GROVE AND FOREST

ASH

The ash is a handsome tree, which usually grows in moist soil. Its elastic tough wood is valuable for making articles where strength and lightness are needed. Some varieties are used in making furniture. Some ash trees grow to a height of nearly a hundred feet. All are stately trees.

PIN OAK

The pin oak is a common eastern oak, readily known by its deeply cut, rather small leaves, and its rather short, but spreading limbs. It is often planted in parks and along avenues. Pin oaks often grow as high as eighty feet, and some have been known to reach a height of 100 feet.

shall never forget them. Such are those borne by the beautiful Tulip Tree, which one might describe as square in general outline, with a notch taken out of each side and another at the tip. We learn from fossil specimens found in rocks that they have changed but little in shape since prehistoric days. Each leaf comes out of the bud folded upon itself, and within an oval case of translucent tissue formed by the two stipules. The stipules open as the swelling leaf comes out, and remain at the base of each leaf-stalk for some time. The leaves of the tulip tree tremble like those of the poplar, and the tree is often called "white" or "yellow" poplar. It bears handsome flowers on the tips of its upturned branchlets. They much resemble tulips in shape and are brilliant yellow, with a splashing of orange and pale green at the base of the cup; the sap-green tone of the foliage about each flower harmonizes most charmingly.

The Tulip Tree is one of the most magnificent trees of our forests. In the prime of life, if it has had sufficient moisture and room, it forms an almost perfect cone from the ground to its topmost spray. It is famous, moreover, for the height and unbroken straightness of its trunk, that rises like a column, no matter how shapeless and broken the head may become. This was observed by the Indians, who took advantage of the softness and lightness of the boles by digging great canoes out of them. Carpenters usually refer to the lumber of the tulip tree as "white wood," and it is a favorite material for finishing the interiors of houses, especially when the woodwork is to be stained and painted, for it is easily worked smooth and soft. Panels of carriages are also made from it.

Even after the leaves drift away, the tree retains its interest, for it is then seen to be laden with countless cones of fruit. When ripe, we discover that the cones are formed by row after row of upstanding winged seeds; and on dry, sunny days we shall find these seeds flaring in circles about the base of the little interior cone they have been overlapping. A stick thrown among them, or even a high wind, will send yellow clouds of the seeds to earth furiously twirling as they descend to scatter far and near, perhaps, and start a new growth of handsome little trees.

THE INDIANS MADE THEIR CANOE PADDLES FROM THE ASH TREE

Other winged paddle-shaped seeds come spinning to their last resting-place from the Ash. They are called "keys," and are gathered into great bunches on the branches, which sweep outward in an interesting double curve and bear leaves having several large leaflets.

There is little of the romance that is gathered about the European ash included in our folklore, but it is justly valued for the strength and toughness, and the elasticity of its wood, which the Indians used for paddles. This was quite convenient since the tree frequently overhangs watercourses. Even nowadays oars are made of ash, as well as tool-handles, wagon-shafts and other parts of vehicles, besides many other things.

THE LIQUIDAMBAR, OR SWEET-GUM

Some of us may have seen "alligator-wood" sold on city streets, and wondered what it really is. The irregular twigs, gray and crested with wavy ridges of a material like ash-colored cork, seem foreign and unlikely to grow in America; yet one can break them from trees within the limits of New York City—trees bearing the sonorous Latin name "Liquidambar," and the less romantic English title "Sweet-gum." Both names refer to its resinous sap, which may be used in place of storax, an incense gum which we get from a relative of the Sweet-gum that grows in Asia Minor.

The Liquidambar grows in Connecticut and southward to the Gulf of Mexico. In youth it appears to take a very slender, spire-like shape, but becomes less shapely as it ages. The leaves are cut deeply into several sharp-pointed lobes, and look like great green stars. In winter the ground beneath a sweet-gum is strewn with curiously spiked or horned balls that prove to be its fruit. A mass of two-beaked hard capsules growing together like a sphere, is each fruit, and there is need of the number of them that we see swinging from the leafless twigs, for there are few fertile seeds in each sphere. It is a great forest tree. The wood takes a soft satiny polish, and is sometimes called satin walnut.

THE PICTURESQUE OUTLINE OF THE PIN OAK

One could write a whole book on the oaks alone of North America. We have

TWO HANDSOME FOREST TREES OF GREAT VALUE

CHESTNUT

The chestnut is a fine forest tree which was formerly of great value, not only for its wood, which is strong and easily split, but for its sweet nuts. For a number of years the American chestnut has been the victim of a blight, caused by a fungus growth that works under the bark. It is hoped that the few surviving trees will start a new, blight-free growth.

SUGAR MAPLE

The sugar maple often grows on rocky hillsides as well as in the woods. A well-grown, shapely maple tree standing alone in a field is a fine sight. Its dark foliage gives a grateful shade in summer. The hard wood is useful for many purposes. The lovely sugar maple is found over a wide area in the eastern part of the United States and Canada.

already spoken of the White and Live oaks. In this story we shall speak of the Pin Oak, one of the most easily recognized and picturesque of our eastern oaks, and one that is frequently planted in highways and parks, because it grows quickly.

In the forest it generally chooses moist, or even wet, soil; and when youthful it is a pyramidal little tree with thickly set branches standing out horizontally all around the stem, and a maze of little branchlets and spiky interwoven twigs.

THE BUTTERNUT

The Butternut, or White Walnut, is nearly related to the Black Walnut, and gives one of the largest and richest of our nuts. The outer hull furnished the colonial yellowish brown dye called "butternut."

But when older, the lower limbs droop until they rest dying and broken against the trunk, while the middle and upper limbs rise in an almost unbroken series of sweeping lines, which gradually change from the droop of the hanging lower limbs to the uprightness of the vertical leader at the top. The small acorns falling from their shallow cups are sometimes striped; the pretty foliage is deeply cut, often nearly to the midribs. The wood is strong, hard and light brown in color.

THE BUTTERNUT—A NUT-BEARING FOREST TREE

A ripe butternut must present a problem to the eager teeth of even a red squirrel; for, when it falls, it is enveloped in a sticky husk, and when this disappears, it leaves a four-ribbed oblong nut two inches long, with a stony-hard shell, bearing thin, saw-edged ridges. All summer, at first soft and green, the butternuts have been ripening in clusters at the top of the branches, tucked in at the bases of the great leaves broken up into many leaflets that are not a whit too big for the fine tree that bears them. In early days a dye called butternut brown was made from this tree—some say from the husks of the nuts (which certainly stain the fingers), while others claim that the inner bark gave the tint which the colonists used to color their homespun cloth.

Blooming under the Wild Red Cherry are the straggling bushes of the Chokecherry, from which hang long clusters of luscious-looking scarlet berries, which will pucker the mouth and throat most amazingly. And near them will spring the Butternut, which shoots up into one of the handsomest of forest trees. It is not often that one can reach the furred twigs, with their sticky half-opened leaves composed of many pairs of long pointed leaflets, and an odd bud at the tip; whence, in early spring, hang tassels of the stamen-bearing flowers, like green catkins. Other flowers hold the pistils, ready to catch pollen; and long afterward these flowers develop into nuts with sweet rich kernels.

We have been told that the Indians smashed the kernels and stirred them in water, making a buttery liquid, from which the name arose. The tree is also called the White Walnut, from its likeness to its cousin the famous Black Walnut, but its wood is soft and light and much paler in color than that of the black walnut, although it looks like it when stained properly, and is frequently used for finishing rooms, making furniture and other cabinet work.

THE WHITE BLOSSOMED SHADBUSH, OR SERVICE-BERRY

The little June-berry adorns itself with slender-petaled white blooms before its cottony leaves have fairly left the bud and while the shad are swimming up the river—whence its homely name of Shadbush.

Service-, or more commonly "Sarvice-" berry, it is also called. It frequently grows into a small, slender tree, and, if the birds would only leave it alone, would ripen its sweetish fruits, very like plump

TREES THAT ARE BEAUTIFUL IN SPRING AND AUTUMN

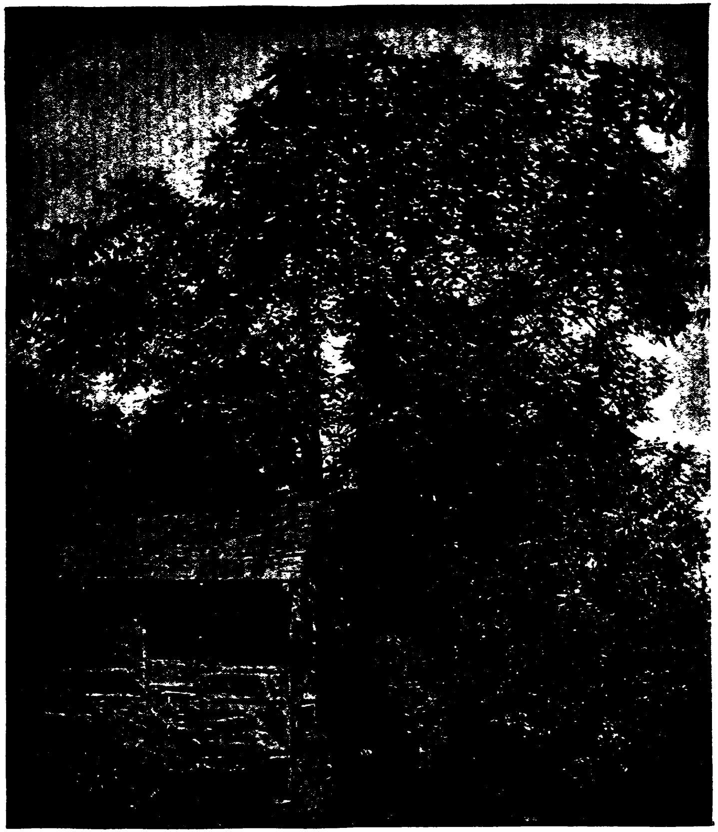
TULIP TREE

The tulip tree is one of the handsomest of our flowering trees. The trunk is tall, straight and column-like. It has squarish deeply notched leaves of peculiar shape, and the striking yellow flowers, shaped like tulips, are beautiful in the spring. The wood is fine-grained and smooth, and is known as white or yellow poplar when used in building or for wooden articles.

LIQUIDAMBAR

The liquidambar, or sweet gum, is so called because of its resinous sap. It is easily known by its curious fruit—like spiked spheres—and by its handsome, star-shaped leaves. It grows throughout a large part of the continent, from Canada to Mexico, and it is beautiful in the autumn when the leaves are red and purple. It is also called red gum and star-leaved gum.

THE BUTTERNUT TREE AND THE HONEY-LOCUST



BUTTERNUT TREE

The butternut, or white walnut, tree is related to the black walnut and the English walnut. In foliage and habit it is much like the black walnut, but is smaller and its wood is not so valuable. Its nuts are as good to eat as hickory nuts. In the early days of our country the pioneer women used to dye homespun clothing with the brownish juice from the hulls of butternuts.

HONEY-LOCUST

The honey-locust is often confused with the black locust, but although the two trees look alike, they are merely relatives. The honey-locust has lovely, sweet-scented clusters of flowers in the springtime. Later these give way to long, dark pods filled with pulp. The Indian children liked to eat these pods. As the seeds mature, the pods get dry and twisted, and the ripe seeds fly off in all directions.

rosehaws in appearance. But the mealy pulp appears to be so delicious to all birds that one scarcely ever finds ripened fruit beneath the cherry-like foliage. It is said that Indians picked the fruits, but I cannot imagine where they found enough to make it worth while. The birds make it practically useless to improve the Service-berry.

It is not from the attack of birds, but from those of little gnawing animals that great nut trees seek to protect the sweet rich kernels of their fruit; and they are not altogether successful, we think, when we notice the number of shells bitten open and emptied by squirrels and chipmunks in a walk through the forest.

THE NOBLE CHESTNUT TREE AND ITS USES TO MAN

It is fitting that our little talk about the Chestnut should come at the end of the story, for unless some clever scientist discovers a remedy for the disease that is killing them, our chestnut groves will soon be destroyed just as the apple orchards are vanishing under the curse of the San José scale. The latter can be controlled by spraying, but the fungous disease of the chestnut, which girdles and soon kills even great trees, works under the bark, and therefore spraying does no good. It will not be long before the noble trees, with their gray deeply furrowed bark and long-pointed sharply toothed leaves, will be only memories, as well as the sweet glossy nuts, hurled by Jack Frost out of the velvet-lined husks in which they have lain all summer protected against bird and beast by the fearful bristling armor of prickles on the outside of those spherical husks. What will the railroads do without their chestnut ties under the rails, riven out of the tough brown durable and easily split wood, or the carpenters, who have used it in finishing houses, or the farmers who have made fence-posts and a thousand and one things out of the chestnut poles? And how we shall miss its great round domes, which lighten the color of the forest in June with their masses of pale yellow tassels of bloom, that will turn no more into the red-brown nuts with the sweet kernels.

We are quite used to eating the sweet chestnuts, but we scarcely think of adding bark to our table dainties. School-children, however, delight in nibbling the smooth thin spicy bark of black birch twigs; and they do not realize that in sub-Arctic Russia the poor peasants depend upon the birch bark to use as a sort of salad in their meals.

The earliest settlers in New England found that certain Indians called "tree-eaters" by wealthier folk ate the tender bark of various trees when they had devoured their scanty winter stores of food. Moreover, in the western states, where the great poplars line the watercourses, the Indians scrape off their sweet and sappy inner bark for a delicacy. "It is their ice cream," said an educated red man. Farther west, the sugar pines and other pines are similarly stripped by little scrapers carried for the purpose.

Blossom and leaf of the Tulip Tree.

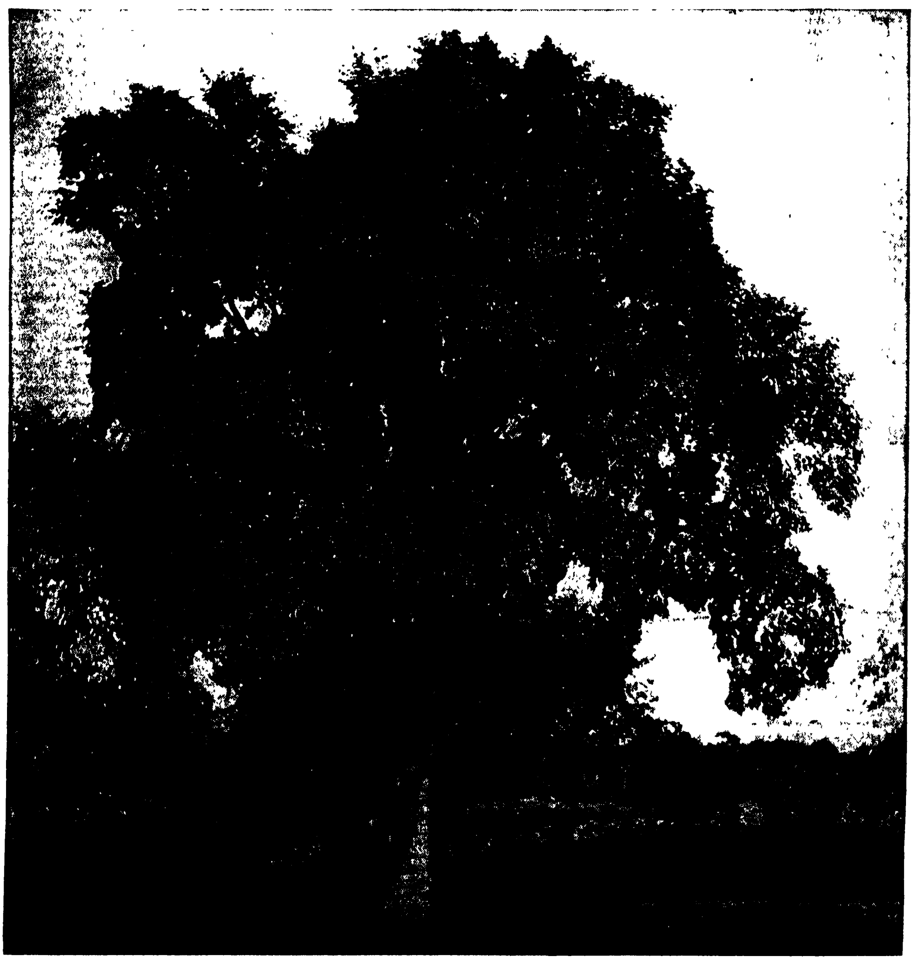
One of the oddest forms of bark-food, that much resembled oakum, or the fibrous coat of a coconut, was offered to explorers on the Pacific coast, who found that they were eating dried hemlock bark soaked in salmon oil, which was, unfortunately, usually rancid.

Besides its occasional use as food, bark is valuable in other ways. That of the hemlock, the oak, the chestnut and the birch is used in tanning leather. And from the thin tough birch bark many articles are fashioned by the Indians.

THE NEXT STORY OF PLANT LIFE IS ON PAGE 4634.

THE AMERICAN ELM AND ITS SEEDS

The light, flat seed of the American elm.



The American elm is a magnificent shade tree with graceful, sweeping branches which give it an unusual appearance of lightness. This tree lives to a great age, and there are many noted specimens, especially in Canada and New England. Compare this elm with the more compact English elm.

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